SCIENCE ABSTRACTS.

Section A.—PHYSICS.

DECEMBER, 1927.

GENERAL PHYSICS.

3020. *Testing of Line Standards of Length.* **L. V. Judson.** (Bureau of Standards, Circ. No. 332. [22 pp.] 1927.)—This circular outlines the methods used in the comparison and standardisation of line standards of length and gives the basis of such measurements in the United States. The apparatus used and the precautions necessary for precise work are considered. Information regarding the testing of line standards and of metal tapes is given, including shipping directions. AUTHOR.

3021. *A Distant-Reading Instrument for the Measurement of Small Deflections.* **E. F. Relf** and **L. F. G. Simmons.** (Phil. Mag. 4. pp. 269–272, Aug., 1927.)—The apparatus described in this paper was developed in response to a need for an instrument which would indicate at a distance the magnitude of the aerodynamic forces acting on models which were mounted in such a way that direct measurement by balance was impossible. It is found that the only practical method of any promise is to cause the force to be determined to deflect a very stiff spring, and to measure this deflection by an electrical method. The apparatus depends upon the change in mutual inductance between two coils mounted on an iron core in which there is an air gap produced by an alteration in the width of the gap. If two such systems are used, one coil of each being supplied (in series) with alternating current, while the other coils are connected so that the induced e.m.f.'s are in opposition, a current will flow in the secondary circuit unless the mutual inductances are equal. The very small alternating currents induced are difficult to measure with accuracy; there is also the disadvantage that an alternating-current measurement would not indicate which inductance was the greater. A device is described and illustrated which permits the use of an ordinary moving-coil galvanometer, and at the same time indicates the sign of the difference between the gaps. A. E. G.

3022. *Apparatus for Carrying Out Physical and Chemical Experiments at Various Temperatures under Liquid Pressures of* 15,000 *Kg./(cm.)*^{2}. **J. Basset.** (Comptes Rendus, 185. pp. 343–345, Aug. 1, 1927.)—The apparatus described enables permanent liquid pressures to be produced in enclosures forming experimental chambers, these pressures being capable of regulation from some hundreds of kilogrammes up to more than 20,000 kg. per sq. cm. It is only after long trials that the methods of fabrication, the qualities of the steel to be employed and the details of assemblage and construction have been brought to such a point of perfection that now such apparatus can be used with complete security and without any danger. The paper is illustrated by a diagram and a photograph of the apparatus described. J. J. S.

3023. *A Mechanical Synthesiser and Analyser.* **F. W. Kranz.** (Frank. Inst., J. 204. pp. 245–262, Aug., 1927.)—An instrument which produces a curve which is the algebraic summation of a number of simple sinusoidal curves, the wave-lengths of these component curves being integral subdivisions of the wave-length of the longest, which is also the wave-length of the resultant. The algebraic sum of the amplitudes of a number of motions is combined in pulls on a cord or chain which passes around pulleys on the moving parts. Registration of the resulting summation is accomplished by a pen or pencil on a carriage attached to one end of the chain. A trace is obtained on a paper carried by a table moving uniformly at right angles to the pen motion. With the arrangement indicated, a sinusoidal curve will be produced by the motion of one pulley if this pulley moves with a simple harmonic motion. The simple harmonic motion of each pulley is produced by the rotation of a circular plate with a projecting pin working in the slot of a sliding element which is constrained by parallel guides to move back and forth along one line. This sliding element carries the pulley and moves with a simple harmonic motion as the plate is rotated with a uniform angular velocity. Each moving element has a different period which is controlled by the period of the corresponding rotating plate. Helical gears are used to connect these circular plates with a main drive shaft, to rotate the plates at appropriate speeds. The driving gears are all attached to a main shaft, and the driven gears are on the shafts of rotation of the various circular plates. The gear ratio was made 1 : 1 for the highest speed plate, while a reduction in the ratio of 40 : 1 was made for the lowest speed or " fundamental " plate. The amplitude of motion of the sliding element carrying the pulley is adjusted by altering the distance of the pin from the centre of rotation of the plate upon which it depends, and the phase of the curve at the beginning of the motion of the pen, while it is dependent on the initial angular position of the plate with respect to the maximum displacement position of the sliding element, is regulated by adjusting the latter. The table which carries the paper is driven from the same main shaft which drives the gears. E. G.

3024. *The Surface-Tension Balance.* **E. L. Warren.** (Phil. Mag. 4. pp. 358–386, Aug., 1927.)—The method now described in detail and discussed theoretically is a modification of Jaeger's method, and has been designed primarily for the experimental determination of the temperature-coefficient of surface tension, and for the investigation of the dependence of the surface tension of solutions on their concentration. The chief feature of the method is that it enables all such measurements to be expressed in terms of the surface tension of some appropriate standard liquid such as water. A comprehensive collection of data is given for the variation of the surface tensions of water and of aqueous solutions of sodium chloride with temperature, and also for the latter with concentration. It is shown that the temperature variation of the surface tension of water cannot be expressed accurately by any equation of the form $T_\theta = T_0(1 + a\theta + b\theta^2 + c\theta^3 + \ldots)$. The paper is replete with diagrams and illustrations. H. H. Ho.

3025. *Surface Tension of Molten Metals. I. Copper.* **E. E. Libman.** (Nat. Acad. Sci., Proc. 13. pp. 588–592, Aug., 1927.)—Except for those that melt at temperatures sufficiently low to allow the use of glass vessels, no accurate data are available concerning the surface tensions of the metals. The writer is engaged in determining the capillary constants of the metals that melt above 900° C., and the present paper is an abstract of the work on copper. Measurements are made from the melting point to 1300° C. on two samples of copper, one of great purity and another not so pure, in order to determine the effect of slight contamination. Tables are given showing the so-called "capillary constant" (a^2) in each case. The probable error of a^2 for the case of pure copper calculated by the method of least squares is 0·0017. It is noted that the effect of impurities becomes more pronounced as the temperature rises. A. E. G.

3026. *New Fundamental Equations of the Mechanics of True Liquids.* **M. Broszko.** (Zeits. f. Physik, 44. 1–2. pp. 146–154, 1927.)—A mathematical paper in which, founded on the knowledge that the viscosity as well as the turbulence has for cause the impulse transport depending upon molecular pulsations, differential equations are established which serve for the exact description of the laminar as well as the turbulent streaming of a true liquid. J. J. S.

3027. *Large Bending of Thin Flexible Strips and the Measurement of the Elasticity.* **F. H. Hummel** and **W. B. Morton.** (Phil. Mag. 4. pp. 348–357, Aug., 1927.)—This paper examines the problem of the large bending of thin flexible strips and the limits within which the approximate formulæ can be used. When the weight of the strip is negligible in comparison with the attached load, the exact solution is expressed by elliptic functions, but for the bending caused by the weight of the strip itself a method of approximation has been worked out. The mathematical analysis is made neater by the introduction of a characteristic load in the first problem and a characteristic length in the second. The paper is entirely mathematical, and the theory made available in several ways for the measurement of Young's modulus. H. H. Ho.

3028. *Mathematical Methods of Frequency Analysis of Size of Particles. Part I. Methods.* **R. P. Loveland** and **A. P. H. Trivelli.** (Eastman Kodak Co., Research Lab. Comm. No. 300. Frank. Inst., J. 204. pp. 193–217, Aug., 1927.)—This paper considers the best procedure for analytical study when given the data from the size-frequency determination of a system of dispersed particles or from a series of such determinations. Almost invariably the determination at the extremity of smaller particle size will be limited by experimental error. The following recommendations are made: (1) Data must usually be put into tabular form of the proper units and adjustment made for irregular class width. (2) Plot on double logarithm paper, which removes the inflection point and simplifies observation of the most reasonable continuous curve representative of the sample. (3) Determine the type of formula best representing the normal function and, if it is non-continuous, analyse the segments. Determine the constants if an explicit formula can be assigned. (4) Calculate the fundamental frequency constants of the observed data, total number, average particle size and dispersion. If a series of distributions is being examined, these constants should be plotted against the factor studied. (5) If it is decided to apply a frequency formula to the data, the normal function should be examined for choice of the type. (6) If the single closed formula does not give a satisfactory fit, due to discontinuities or otherwise, it should be used as the generating function of a translated Charlier series. A comprehensive bibliography is included in the paper. H. H. Ho.

3029. *Exact Determinations of the Lattice Constants for Magnesium Oxide, Sulphide and Selenide, and Manganese Oxide and Selenide.* **E. Broch.** (Zeits. phys. Chem. 127. 5–6. pp. 446–454, 1927.)—The following results, obtained by the powder method, are given. For magnesium oxide, a_w = (1) 4·208 ± 0·001 Å., (2) 4·207 ± 0·002 Å.; magnesium sulphide, (1) 5·190 ± 0·002 Å., (2) 5·190 ± 0·003 Å.; magnesium selenide, (1) 5·452 ± 0·002 Å., (2) 5·451 ± 0·001 Å.; manganese oxide, 4·435 ± 0·002 Å.; manganese selenide, 5·448 + 0·002 Å. T. H. P.

3030. *Crystal Structure of $MoSi_2$ and WSi_2.* **W. Zachariasen.** (Zeits. phys. Chem. 128. 1–2. pp. 39–48, Aug., 1927.)—The structure was determined by the powder method; both substances have tetragonal crystals. Lattice dimensions; $MoSi_2$, $a = 3·200 \pm 0·005$ Å., $c = 7·861 \pm 0·005$ Å., $c/a = 2·457$, calculated density 6·24; WSi_2, $a = 3·312 \pm 0·005$ Å., $c = 7·880 \pm 0·005$ Å., $c/a = 2·453$, calculated density 9·75. The lattice cell is body centred and contains two molecules; space group holohedric D_{2h}^{17}; position of atoms, Mo or W $(0\,0\,0)\,(\frac{1}{2}\,\frac{1}{2}\,\frac{1}{2})$, Si $(0\,0\,u)\,(0\,0\,u)\,(\frac{1}{2}\,\frac{1}{2}\,\frac{1}{2}+u)\,(\frac{1}{2}\,\frac{1}{2}\,\frac{1}{2}-u)$, where $u = 0·333 \pm 0·015$. The structure belongs to a new type; a Mo atom is surrounded by 10 Si atoms at 2·617 Å. (2·625 Å. for WSi_2), and each Si atom by 5 Mo or W and 5 Si atoms at the same distances. H. N. A.

3031. *Structure of Yellow Lead-Oxide.* **F. Halla** and **F. Pawlek.** (Zeits. phys. Chem. 128. 1–2. pp. 49–70, Aug., 1927.)—A study by the powder, Lane and rotation photographic X-ray methods. The yellow rhombic modification crystallises in the space-group C_{2v}^{11}, Q^8 or Q_h^{19}, probably the latter. The unit cell of dimension $a = 5·50 \pm 0·02$, $b = 4·72 \pm 0·03$ and $c = 5·880 \pm 0·003$ Å. contains four molecules of PbO, but is a molecular lattice of the double molecule Pb_2O_2. W. H. Ge.

3032. *The Grating Constants of CaO, CaS, CaSe, CaTe.* **I. Oftedal.** (Zeits. phys. Chem. 128. 1–2. pp. 154–158, Aug., 1927.)—Precision measurements have been made by the powder method, mixing with NaCl for comparison measurements. The results are tabulated. CaTe is seen to belong to the CaCl type. J. E.

3033. *Some Crystal Structures of the Type NiAs.* **I. Oftedal.** (Zeits. phys. Chem. 128. 1–2. pp. 135–153, Aug., 1927.)—It has been established that the compounds CoSe, CoTe, MnTe, CoTe, N_1Te, CrSb, Mn_x, Sb_y, Fe_x, Sb_y, CoSb, have the NiAs structure. Precision measurements on these and on NiSb have been made and the results are tabulated. The relations between the distances of nearest approach of the atoms in such compounds have been worked out by Goldschmidt. Here only the gradual change of this distance with increasing atomic number is remarked. This change runs parallel in the tellurides, selenides and antimonides.

J. E.

3034. *Crystal Fracture.* **F. Sauerwald and G. Elsner.** (Zeits. f. Physik, 44. 1-2. pp. 36–57, 1927.)—Deals with an experimental study of the influence of temperature and time for the metals aluminium, iron and copper.

W. H. GE.

3035. *The Gibbs-Ewald Reciprocal Lattice and the Space Appertaining to it.* **A. L. Patterson.** (Zeits. f. Physik, 44. 8. pp. 596–599, 1927.)—This lattice has been used by Ewald, by Bernal and by v. Laue in connection with crystal problems. The author shows how the space appertaining to it can be derived from ordinary space by means of a transformation which rests on Fourier's integral law.

H. N. A.

3036. *Hexagonal Crystal Structure of Thallium.* **G. R. Levi.** (Zeits. f. Physik, 44. 8. pp. 603–606, 1927.)—Continues the discussion on the relative merits of the proposed two structures, hexagonal or tetragonal, for thallium, and gives goniometer measurements in support of the former. [See Abstract 2215 (1927).]

W. H. GE.

3037. *Xenotime Structure.* **L. Vegard.** (Phil. Mag. 4. pp. 511–525, Sept., 1927.)—The structure of xenotime (YPO_4) has been reinvestigated by the powder and rotating single crystal X-ray photographic methods, and the previous result, that xenotime and zircon ($ZrSiO_4$) have the same crystal structure, has been confirmed. The new measurements are $a = 9{\cdot}735$ Å., $c = 6{\cdot}013$ Å., $c/a = 0{\cdot}6177$ with parameters $\alpha = 58°$ $\gamma = 22°{\cdot}5$. [See Abstract 504 (1917).] The bearing of the results on the relation between *chemical constitution and crystal structure* is discussed in detail, valency, volume conditions and atomic forces all being treated.

W. H. GE.

3038. *Numerical Determination of the Mean Values between the Ortho- and Para-Terms of He and Li⁺ with Consideration of the Polarisation Term in the Quantum Mechanical Disturbance Theory.* **Y. Sugiura.** (Zeits. f. Physik, 44. 3. pp. 190–206, 1927.)—If the reciprocal effect of electrons in the problem of several bodies be treated according to quantum mechanics, then Heisenberg has shown [see Abstract 1648 (1927)] that the adiabatic disturbance and resonance effect must be considered. The mean and difference between the ortho- and para-terms were calculated by Heisenberg for the atomic system with two electrons, but his first approximation for the P-terms was inexact and invalid for the S-terms. Waller [see Abstract 365 (1927)] applied the theory to the Stark effect of the second order for atomic systems with two electrons, and obtained the adiabatic polarisation term in the disturbance if one electron is a great distance from the nucleus. In the present paper the central field for the outer electron of He and Li^+ has been ascertained and the adiabatic reciprocal effect between two electrons considered to the second order. The numerical determination of the mean value between the ortho- and para-terms (S and P) was then established by the rational solution of the

Schrödinger equation for this central field and, in addition, the distance ($\Delta\nu_{2p}$ cm^{-1}) calculated between the extreme components of the fine structure lines. **H. H. Ho.**

3039. *The Ratio between the Surface Energies of Different Rock-Salt Surfaces.* **W. D. Kusnezow** and **N. A. Bessonow.** (Zeits. f. Physik, 44. 3. pp. 226–234, 1927.)—Kusnezow has previously shown that true splitting of rock-salt is only possible in (100) surfaces [see Abstract 2450 (1927)]. The calculated surface energies for (110) and (111) surfaces is so large compared with that of the (100) surface that splitting gives a stepped surface in one case, and one made up of pyramidal hillocks in the other, the minute surfaces formed being all (100) surfaces. The actual surface, and so the surface energy per unit of apparent surface, in the first case is $\sqrt{2}$ times that for (100), and in the second $\sqrt{3}$ times. By grinding the three different surfaces mentioned, and determining the amounts of mechanical energy required to remove a given amount of NaCl from each of them, the authors have found that the ratio between these energies, $U_{(100)} : U_{(110)} : U_{(111)} = 1 : \sqrt{2} : \sqrt{3}$, which agrees with that for the surface energies. It is shown that this is to be expected from the theory. **H. N. A.**

3040. *Theory of the Isotope Effect in Line Spectra.* **G. Joos.** (Ann. d. Physik, 83. 7. pp. 1054–1064, Aug. 9, 1927.)—Considers the effect of the mass of the nucleus on the quantum state, first in the case of a nucleus with one electron, hydrogen or He$^+$, which from this point of view can be regarded as isotopes, then for atoms with heavier nuclei, and a number of electrons, $n - 1$ of which form with the nucleus the atomic trunk, while the outermost behaves towards the trunk like the single electron does to the single proton in the H atom. Formulæ are derived for two cases, that of the photoelectron, the orbit of which dips into the trunk, and where the orbit lies outside the trunk; in the first case the mass effect can alter the term by an amount considerably greater than that produced in a system like that of hydrogen, while in the second there are only small positive or negative differences. The mathematical results are compared with observation. It appears that in the case of neon the splitting up of lines observed by Hansen must be regarded as due to the masses of the nuclei, and that it is not necessary to ascribe it to a difference in nuclear structure in the isotopes. **H. N. A.**

3041. *Spectral Relationships of Lines Arising from the Atoms of the First Row of the Periodic Table.* **R. A. Millikan** and **I. S. Bowen.** (Phil. Mag. 4. pp. 561–580, Sept., 1927.)—The authors, by means of their work in hot-spark vacuum spectrometry combined with the results of other investigators, have arrived at a practically complete understanding of the radiation that can be emitted by these atoms in all stages of ionisation. The older methods for identification of the lines have been supplemented by extending the X-ray laws into the field of optics, and the new rules of Russell, Pauli, Heisenberg and Hund, developed in the study of calcium and the other elements of the first long period, have been made use of for the more complex of the first-row spectra. A table is given, showing that the empirical rule of Hund, that the separations are normal until a shell has become just half filled and then becomes inverted, holds for the first-row elements. It is shown that a series of atoms of like electronic structure, but varying charge, always leads to a Moseley straight line for the relation between atomic number Z and the square root of the frequency. The ionisation potentials are given for all the atoms of the first row, in all degrees of stripping for which the limit of the appropriate series has been obtained. Some of these are of importance in fixing star temperatures. An appendix deals in detail with the application of the rules to one-electron systems and to two, three, four, five, six and seven-electron systems. H. N. A.

3042. *The Deviation of Molecular Rays of Molecules with Electrical Dipoles in a Nonhomogeneous Electrical Field.* **E. Wrede.** (Zeits. f. Physik, 44. 4–5. pp. 261–268, 1927.)—The vacuum apparatus required to produce the beam of molecules, containing a small oven for vaporising the salts employed, with slits to limit the beam, electrodes to produce the field which deviates it, and a polished silver disc on which the beam impinges and is condensed, is described, together with the rather complicated adjustments which are required. The portion of the vacuum tube outside the oven is cooled by means of liquid air. The deposit on the silver is developed by means of mercury vapour. Photographs are reproduced showing the effect produced with different salts. O. Stern has calculated from the observations on KI an electrical moment of some 10^{-17} in C.G.S. units, which agrees in order of magnitude with the theoretical value of Born and Heisenberg. The moment of TlI is considerably smaller, and those of NaI, CoCl and RbI are apparently still smaller. H. N. A.

3043. *Combination Principle.* **V. Dolejšek.** (Comptes Rendus, 184. pp. 1118–1120, May 9, 1927.)—The author sums up the brief remarks of this paper in the statement of a " law " : " The passage of an electron between two (atomic) levels gives birth to a line, when the equations of these two levels have a similar affinity to the ' characteristic ' of the degree above as the line produced has to the ' characteristic ' of the degree below." [See Abstract 2077 (1927).] A. B. W.

3044. *Electric Moment of the Sulphur Complex.* **A. M. Taylor** and **E. K. Rideal.** (Roy. Soc., Proc. 115. pp. 589–609, Aug. 2, 1927.)—An infra-red examination of various forms of sulphur shows the existence of electromagnetically active vibrations, and it is inferred that electric doublets are present in the sulphur complex. These doublets are believed to be units S_2 built into groups $(S_2)_8$ corresponding to the groups of mass 512 whose centres of gravity occupy the points of the diamond-type space lattice of rhombic sulphur. The frequencies ascribed to S_2 persist throughout the rhombic, prismatic and liquid phases. Calculations of the electric moment of the S_2 group from the heat of vaporisation, the heat of dissociation and the infra-red spectrum all agree. The linkage between atoms in the element sulphur is thus believed to be pseudo-heteropolar. W. H. GE.

3045. *Atom Models.* **F. J. v. Wisniewski.** (Zeits. f. Physik, 44. 4–5. pp. 385–391, 1927.)—Following up a previous paper [see Abstract 2260 (1926)], it is shown that for hydrogen the biatomic model, and for helium the monatomic model, enable the ionisation potential and the diamagnetic susceptibility to be directly computed; but for the dielectric constant the defining equation must be similarly altered for the two in a sense different from that applicable to other gases. The biatomic model of CO_2 (two electrons and CO, O) enables the diamagnetic susceptibility to be computed. A. D.

3046. *Reciprocal Action of Neutral Atoms and Homopolar Combination according to Quantum Mechanics.* **W. Heitler** and **F. London.** (Zeits. f. Physik, 44. 6–7. pp. 455–472, 1927.)—According to the new quantum mechanics the force between two neutral atoms may have different values in different circumstances, and this fact seems suited for dealing with the different behaviour of such atoms which is shown to exist experimentally. In hydrogen, for example, homopolar combination may take place between two neutral atoms, or on the other hand they may reflect one another elastically. The wave equation for this gas is shown to have two solutions, one of which gives attraction for moderate distances between the atoms and repulsion for small distances, and may produce homopolar combination; the other causes repulsion in all cases and corresponds to the van der Waals' *b* force. In the case of helium only the second solution has any physical meaning for unexcited atoms, the other solution being excluded by the Pauli principle, which holds for systems of atoms as well as for single atoms. H. N. A.

3047. *Atomic Diameters and the Photoelectric Effect.* **E. N. Gapon.** (Zeits. f. Physik, 44. 6–7. pp. 535–536, 1927.)—The limiting frequency in the red for the occurrence of the photoelectric effect, multiplied by h, gives the work necessary to separate the electron from the atom and then to pass it through the surface of the metal. Neglecting the latter contribution and assuming the electron in the atom to be describing a circular orbit about a nucleus consisting of one positive, a linear relation is obtained between the radius of the orbit and the wave-length in the red at which the photoelectric effect ceases. Values of this radius are computed from the photoelectric data and compared with the values of the atomic radius derived by W. L. Bragg from crystal structure considerations. W. S. S.

3048. *Magnetic Electrons and Mechanics of Wave Motion.* **L. Rosenfeld.** (Comptes Rendus, 184. pp. 1540–1541, June 20, 1927.)—Based on the theory set out in five-dimensional analysis the author gives a formula, or de Broglie function, for an electron rotating about an axis *or* with a kinetic couple M. The variable ϕ_1 (angle of rotation) is dealt with by the Schrödinger process, and terms of any possible processional movements of the magnetic axis, as, for example, around the axis of an external magnetic field, are taken into account together with other terms, such as the potential vector. C. W. O.

3049. *Scattering of Magnetic Electrons.* **W. Bothe.** (Zeits. f. Physik, 44. 8. pp. 543–548, 1927. From the Reichsanstalt.)—The orbit of a magnetic electron projected at a positive nucleus is derived using relativistic equations of motion. The angle between the asymptotes of the initial and final parts of the orbit agrees with that given by Rutherford's scattering theory, for electrons which do not pass too near the nucleus.

For electrons the initial directions of which are distant less than 10^{-10} cm. from the nucleus, the scattering law is quite different from Rutherford's result. In addition two cases have to be distinguished corresponding to the two possible orientations of the magnetic electron in the magnetic field due to its own motion. The scattering laws being different for the two cases, at a particular scatter angle the electrons of one orientation will predominate. If the beam scattered at a particular angle is re-scattered the distribution law will depend on the original scatter angle. W. S. S.

3050. *Mechanism of Emission according to Undulatory Mechanics.* **E. Fermi.** (Accad. Lincei, Atti, 5. pp. 795–800, May 15, 1927.)—The Schrödinger wave equation for an atom, in the form

$$\text{grad div}\,\psi - \frac{8\pi^2 m}{h^2} V_0 \psi - \frac{4\pi i m}{h}\frac{\partial\psi}{\partial t} = 0,$$

has the general normalised solution

$$\psi = \Sigma\lambda_k u_k \exp.(2\pi i \nu_k t), \quad \nu_k = E_k/h, \quad \Sigma\lambda_k\bar{\lambda}_k = 1,$$

where the λ_k's are constant parameters and the E_k's and the u_k's are the eigen energies and the normalised eigen functions of the equation

$$\text{grad div}\,u + \frac{8\pi^2 m}{h^2}(E - V_0)u = 0.$$

This solution corresponds to a variable electric moment p, the radiation from which on the classical theory would exert a reactive force of amount $\frac{2}{3}\frac{e}{c^3}\dddot{p}$. To take account of this force in the Schrödinger equation a potential $V = -\frac{2}{3}\frac{e}{c^3}\dddot{p}\,r$ is added to V_0, where r is the radius vector to the field point. The resulting modification in the solution is obtained by allowing the parameters λ_k to vary with the time. In the simple case where only two of the λ_k's have values different from zero, it is shown that as the time t increases from $-\infty$ to $+\infty$ the λ_k corresponding to the greater eigen energy decreases from unity to zero, and that corresponding to the lesser eigen energy increases from zero to unity. This represents physically the quantum jump from the higher to the lower energy state. The variable electric moment for this case is developed as a Fourier integral from which is deduced a value for the natural breadth of the spectral line to which the emitted radiation corresponds. W. S. S.

3051. *Length of Free Path and Quantisation of Molecular Translation.* **W. Heitler.** (Zeits. f. Physik, 44. 3. pp. 161–169, 1927.)—The older quantum theory could only deal with definitely periodic motions. In other cases it was necessary by a forced "idealasition" to reduce the problem to one of periodic motion. The author investigates by means of wave mechanics the Eigenwert spectrum of molecular translation in a solid lattice, and obtains a definite solution of the problem. A cubical space is considered, and in the first instance the alteration of the Eigenwert caused by placing at each lattice point three minute surfaces at right angles to one another, parallel to the cube surfaces, giving a new boundary condition, is dealt with. Afterwards these minute surfaces are replaced by small hard spheres at the same points. It is shown that the spectrum is essentially a continuous one, but there are weak maxima and minima of the statistical weight, which are repeated periodically. There is a relatively very large zero-point energy which vanishes with the radius of the lattice molecules. H. N. A.

3052. *The Quantum Mechanics of Simple Types of Motion.* **E. H. Kennard.** (Zeits. f. Physik, 44. 4–5. pp. 326–352, 1927.)—In this paper the quantum mechanical solutions for simple types of motion (the electron in the homogeneous electric or magnetic field, oscillators) are given according to the Dirac-Jordan-Heisenberg methods [see Abstract 1292 (1927)]. The result can be formulated that the difference between the quantum and classical theories in such simple cases only arises in the Heisenberg indeterminate relation between the values of canonical conjugated variables. The assumption, therefore, must be made that the wave-packet of Schrödinger is to be regarded as a probability packet in the sense of the new theory. The paper also contains a more detailed mathematical treatment of certain aspects of the above theory than has hitherto been published. H. H. Ho.

3053. *Aperiodic Phenomena in Quantum Mechanics.* **J. Placinteanu.** (J. de Physique et le Radium, 8. pp. 284–288, June, 1927.)—Born and Jordan [see Abstract 2492 (1925)] have employed the method of perturbations for calculating the variations of energy and of action variables according to classical mechanics in order to study aperiodic phenomena in the classical theory of quanta. In the present paper the change of energy between matter and radiation is calculated according to the Heisenberg quantum mechanics by taking as model the corresponding quanto-mechanics of the classical dipole. Expressions are derived for the cases of stationary and variable electric fields and also for spontaneous emission which are the Einstein probabilities that define the stationary variations of the atoms. H. H. Ho.

3054. *Quantum Mechanics of Impact Processes.* **P. Dirac.** (Zeits. f. Physik, 44. 8. pp. 585–595, 1927.)—Born has recently dealt with the impacts of a particle on a scattering body. He employed the space coordinates of the particle, the *q* variables [see Abstract 43 (1927)]. The scattering of light by atoms can be regarded as an impact process of light quanta on atoms, provided the intensity is small, so that the quanta can be regarded as independent of one another instead of satisfying the Einstein-Bose statistics. It appears more convenient to use the *p* variables (impulse variables) in this problem, since it is difficult to speak of the space coordinates of a light quantum, and the polarisation of the quantum causes difficulties when the *q* variables are used. The author obtains in this way the probability of scattering and the "yield" or "output" function, by investigating the points of singularity of the wave function. When the particles or quanta are absorbed the method gives the breadth of the absorption line. H. N. A.

3055. *Schrödinger's Wave Mechanics and the Author's Mechanical Theories.* **A. Korn.** (Zeits. f. Physik, 44. 9–10. pp. 745–753, 1927.)—The author discusses points of contact and divergencies between Schrödinger's wave mechanics and his own mechanical theories. For a mechanical basis to the former it is shown that the equations of motion of frictional compressible fluids can lead to wave equations of the same form as those in the Schrödinger wave mechanics. A combination of the theories is found to be possible which enables the explanation of certain difficulties in Schrödinger's fundamental assumptions. A bibliography of the author's mechanical theories is included. H. H. Ho.

3056. *Energy Exchange according to Wave Mechanics.* **E. Schrödinger.** (Ann. d. Physik, 83. 7. pp. 956–968, Aug. 9, 1927.)—A mathematical paper treating the subject by means of wave mechanics and the quantum theory. J. J. S.

3057. *Application of Schrödinger's Wave Functions to the Calculation of Transition Probabilities for the Principal Series of Sodium.* **Y. Sugiura.** (Phil. Mag. 4. pp. 495–504, Sept., 1927.)—Kramers has shown that a first approximation to the wave mechanical problem of an electron in a central force field is obtained by using an orbital model fixed by the usual quantum conditions, but with half-quantum numbers in place of the normal integral values. Using this result it is found possible, knowing the spectral terms for sodium, to derive the form of the central force law to which the spectrum corresponds. The appropriate potential energy function is then inserted in Schrödinger's wave equation and the normal functions evaluated. The Heisenberg matrix elements are obtained by quadrature and using an argument based on Einstein's conception of spontaneous transitions, the transition probabilities and the number of dispersion electrons for the principal lines of sodium are deduced. Agreement with an experimental result of Minkowski is obtained. W. S. S.

3058. *The Outstanding Problems of Relativity.* **E. T. Whittaker.** (Nature, 120. pp. 368–371, Sept. 10, 1927. Presidential Address read before the British Assoc., Leeds, Sept., 1927.)—Contemporary relativity problems are briefly and critically reviewed. The need for enunciating the axiomatics of general relativity is stressed. J. S. G. T.

3059. *Theory of the Motion of Matter and Light in a Gravitational Field.* **W. Laschkarew.** (Zeits. f. Physik, 44. 4–5. pp. 361–368, 1927.)—Independently of the postulates of the general theory of relativity, the three crucial deductions of that theory are derived from a generalisation of Hasenöhrl's principle, *viz.*, that potential and kinetic energy are to be similarly regarded so far as the determination of mass is concerned, so that the mass m of a particle is equal to W_0/c^2, where W_0 represents the total energy and is constant. J. S. G. T.

3060. *Dynamics of the General Theory of Relativity.* **K. Lanczos.** (Zeits. f. Physik, 44. 11–12. pp. 773–792, 1927.)—A dynamical theory based upon the relativistic field equations and the reciprocal actions of the fields involved is developed. The general acceleration field comprises a translation, an elastic deformation and a rotation of the field. The translatory acceleration conforms with the geodetic principle, whilst the rotation of the field is closely analogous to the rotation of an electron in a magnetic field. The moving field takes the place of the material tensor entering into the more customary dynamical theory, and in place of the field being transported by matter the present theory contemplates matter being carried by the field. J. S. G. T.

3061. *A Redetermination of the Newtonian Constant of Gravitation.* **P. R. Heyl.** (Nat. Acad. Sci., Proc. 13. pp. 601–605, Aug., 1927.)—The results of a preliminary determination of the gravitational constant, employing the method used by Braun, gives the value $(6\cdot664 \pm 0\cdot002) \times 10^{-8}$ for the value of this constant. The five values obtained all agreed to the third significant figure. J. S. G. T.

3062. *The Equations of Electromagnetism.* **F. Gonseth** and **G. Juvet.** (Comptes Rendus, 185. pp. 341–343, Aug. 1, 1927.)—Referring to a previous paper by T. Kaluza [see Abstract 693 (1922)], in which the author endeavoured to bring the theory of the electromagnetic field into a relativity of five dimensions, they point out that the ordinary expression of pondero-motive force, according to Lorentz, leads to a theory of this kind, and they develop this thesis in the present mathematical paper. **Errata** (*ibid.* p. 483, Aug. 22, 1927). J. J. S.

3063. *The Space Metric of Five Dimensions of Electromagnetism and Gravitation.* **F. Gonseth** and **G. Juvet.** (Comptes Rendus, 185. pp. 412–413, Aug 17, 1927.)—This paper is a continuation of the mathematical discussion of this subject given in a previous note [see preceding Abstract]. J. J. S.

3064. *A Theory of the Gravitational Field in the Light of Maxwell's Theory.* **C. K. V. Row.** (Phys. Rev. 30. pp. 189–200, Aug., 1927.)—A complete theory of the gravitational field, possessing all the advantages of Einstein's theory for describing inertial and gravitational phenomena, is formulated without recourse to the hypothesis of equivalence or to non-Euclidean geometry. The principles of mechanics, including the theorems of energy and momentum, are deduced from the laws of gravitation, and Newton's inertial frame is shown to mark a fundamental physical medium in which matter is embedded. The medium is modified near large masses, and this modification accounts for the observed values of the spectral shift and the deflection of light. The fine structure of spectral lines and the variation of electronic mass with velocity are likewise accounted for. A re-examination on the observational side is called for before the problem of the advance of the perihelion of Mercury can be discussed. J. S. G. T.

3065. *The Physical Form of the Ether.* **D. Meksyn.** (Phil. Mag. 4. pp. 272–300, Aug., 1927.)—This is a mathematical paper in which the subject is considered under the following heads: Character of the laws of the ether; some instances of the form of the ether; ether and motion; the law of the ether for moving systems. Dynamics of a material point, including motion and the metric of ether; hyperbolic motion; solution of the equations of motion; harmonic motion; rotation; Einstein's law of gravitation. Dynamics of a continuous medium, including the law of continuity and the law of motion. Electrodynamics, including the electromagnetic equations; motion of electrons (equilibrium of the ether; an electron in its own field; the field of a moving system;

Lorentz transformations for hyperbolic motion; the electromagnetic field of hyperbolic motion. Ether and matter, including the elasticity of the ether; strains in the ether; stresses in the ether; the strain-energy function of the ether and the stability of electrons; the fundamental form of the theory of relativity; gravitation and the electrostatic field of protons. A. E. G.

METEOROLOGY AND GEO-PHYSICS.

3066. *The Instantaneous Displacement Field of Isobars.* **Dedebant.** (Comptes Rendus, 185. pp. 359–361, Aug. 1, 1927.)—Assuming an equation for the position of the isobar of the form $p(x, y, t) = 0$, the author gives as an approximate relation for the rate of displacement of the isobar $\omega = 4\cdot5\text{T}/\text{G}$, where ω is expressed in km. × 100 per 12 hours, T is the barometer tendency in mm., and G the barometric gradient in mm. per geographical degree. From this curves of equal displacement, positive or negative, can be traced, and thence a procedure for forecasting barometric changes will follow. Its practical value is small, but it provides interpretations of some rules of forecasting of which (*a*) Dunoyer and Reboul's regarding the deepening of a depression or the formation of an anticyclone, and (*b*) Clement Ley's regarding the direction of movement of a depression, are examined. If, instead of pressure, its variation in a short interval of time is used, the equation takes the form of $\omega = 4\cdot5[\text{T}(t) - \text{T}(t - \Delta)]/g$, where $\text{T}(t)$ and $\text{T}(t - \Delta)$ are the tendencies in times t and $(t - \Delta)$ respectively, and g is the isallobaric gradient. A field of displacement of isobars can then be used in the study of the method of variations. R. S. R.

3067. *Note on the So-called Barometer Effect of Height Radiation.* **W. Kolhörster.** (Zeits. f. Physik, 44. 9–10. pp. 754–755, 1927.)—From the given data for the opposed behaviour of air pressure and intensity of height radiation the usual values of the absorption coefficients of high radiation have been measured and found to agree with those obtained for thick layers on the assumption of a simple absorption law. H. H. Ho.

ASTRO-PHYSICS.

3068. *Relations between Solar Eruptions and Terrestrial Magnetic Storms.* **G. Abetti.** (Accad. Lincei, Atti, 5. pp. 721–726, May 15, 1927.)—Consisting almost entirely of a review of the work of previous investigators, the object of the paper is to draw attention to a few of the most noteworthy cases in which spectroheliographic observations have with some probability established a correspondence between a given solar eruption and a terrestrial magnetic storm and, confirming the hypothesis of Tacchini and Hale, have assigned a value to the velocity of transmission of the perturbations from the sun to the earth. It appears from these observations that a mean period of 25·6 hours intervenes between the solar eruption and the commencement of the magnetic storm, and that a velocity of transmission of about 1600 km./sec. may therefore be considered as fairly well established. E. F.

3069. *Most General Internal Motion of a Mass of Heterogeneous Fluid Rotating about an Axis.* **P. Dive.** (Comptes Rendus, 185. pp. 378–380, Aug. 8, 1927.)—Shows that it is possible to have a motion not satisfying the conditions given by Wavre [see Abstract 2004 (1927)]. W. G. B.

3070. *Further Radiometric Measurements of Mars,* 1926. **W. W. Coblentz** and **C. O. Lampland.** (Bureau of Standards, Sci. Papers, No. 553. pp. 237–276, 1927.)—The measurement of radiation from the planet Mars at the opposition of 1926 was in continuation of the work carried on in 1922 and 1924 at the Lowell Observatory, Flagstaff, Arizona, using the Lowell 42-in. reflector and a series of thermocouples in vacuum cells. The planetary radiation was resolved into spectral components by means of a series of transmission screens of water, quartz, glass and fluorite. The measurements were reduced to temperatures by three independent methods of analysis, which gave concordant results; and these showed, as before, that bright areas on the planet are cooler than adjacent dark areas, that the summer hemisphere is warmer than the winter hemisphere, and that the forenoon side is cooler than the afternoon side, unless there happen to be sunset clouds. This year clouds were frequently observed on Mars. An important result is the demonstration that the surface temperature of the summer hemisphere rises considerably above the freezing point of water, which has for years been a disputed question. Noonday temperatures of from 10° to 20° C. have been deduced from the observations. M. A. E.

3071. *An Unusual Spectroscopic Binary* (27 *Canis Majoris*). **O. Struve.** (Astrophys. J. 65. pp. 273–285, June, 1927.)—The velocity curve of the spectroscopic multiple star 27 Canis Majoris was derived from forty-eight spectrograms obtained at the Yerkes Observatory and from ten earlier Lick observations. The lines of two components, A and C, are visible in the spectrum. Variable bright hydrogen lines are present. The spectral type of A is B5*ne* while that of C is B8. Component A has a shorter period of 121 days, indicating the presence of an invisible component B. The semi-amplitude of this variation in velocity is 25 km./sec., and the orbit is circular. C is probably also double: an invisible companion D seems to revolve around it in a period of something like eight days with K roughly equal to 50 km./sec. The system C + D revolves around A + B in a period of 3·2 years. In this orbit K = 110·5 km./sec. and $e = 0{\cdot}33$. The total minimum mass of the quadruple system is 950 times that of the sun. The mass ratio of C + D to A + B is approximately one, but the ratios of A to B and of C to D are not known. On the average, each of the four components has a mass of at least 238 times that of the sun. These masses are larger than any that have hitherto been found. An inspection of the observational material shows that the only orbital element that can seriously affect the mass is the eccentricity. But even under the most liberal assumptions concerning e the masses remain unusually large. The possibility is discussed that the observed shifts of the spectral lines are not due to Doppler effect, or that the adopted period is in error. Neither assumption is satisfactory. AUTHOR.

3072. *Orbit of the Spectroscopic Binary* 36 τ^9 *Eridani.* **O. Struve** and **C. Hujer.** (Astrophys. J. 65. pp. 300–314, June, 1927.)—The radial velocity of 36 τ^9 Eridani was measured on fifty-three one-prism spectrograms. The period was found to change appreciably during the course of one year. Between September, 1926 and February, 1927, P = 0·85437 day. This period does not satisfy our observations of 1924–26, requiring a correction of + 0·0009 day to bring them into agreement with the later observations. An average period of 0·8544075 day is indicated, but the deviation from this value in 1926–27 is well marked. The orbital elements were derived from the observations of 1926–27, and a least-square solution was carried through. The orbit is circular; the semi-amplitude of the variation in velocity is 35·7 km./sec., and the velocity of the system is + 19·7 km./sec. The lines of the second component could be measured on several plates, and the resulting mass-ratio is 0·35. The silicon lines λ4128 and λ4132, which are unusually strong in the spectrum of this star of type A0, give the same velocity as the other lines. The spectrum resembles that of α Canum Venaticorum, but the Europium lines are absent or very faint. Some of the lines are suspected to vary in intensity. These are identical with the so-called "second group" of variable lines in α Canum Venaticorum. The two components of this system are believed to be almost in contact. The small width of the absorption lines is probably due to the fact that the planes of orbital motion and of axial rotation of the two stars coincide and that their inclination is small. AUTHORS.

3073. *Researches on Proper Motions of* 3802 *Stars.* **V. Nechvile.** (Bull. Astronomique, 5. 3, pp. 223–317, 1927.)—The material consists of twenty-two regions photographed at Paris in 1922–24 and at Prague in 1924–26. A table and a curve give the frequency of proper motion (μ) between the limits of 0″·01 and 0″·20 a year (showing a maximum at 0″·03–0″·02); for μ greater than 0″·02 an analytical expression is given, in van Rhijn's form, as $N_\mu = A_1e^{-h_1^2\mu^2} + A_2e^{-h_2^2\mu^2} + A_3e^{-h_3^2\mu^2}$. For the twenty-two regions the motions of (402) stars exceeding 0″·08 a year are tabulated and diagrams drawn for each. A list is given of new doubles found, having large motion. The author finds that the mean motion of faint stars near the galactic pole is larger and the absolute magnitude smaller than those galactic stars having the same apparent magnitude; that the space density of stars, in the central mass of the galaxy, diminishes with distance from the curve in conformity with Seeliger's hypothesis; that the interstellar kinetic energy is nearly constant between distances 200 and 1100 parsecs; that for stars between magnitudes 5 and 16 the frequency curves give a distribution of velocities conformable to the ellipsoidal hypothesis in thirteen cases and opposed to it in nine cases; that the R.A. and Dec. of the solar apex increases with diminishing magnitude. A. S. D. M.

3074. *Saha's Theory and Deviations from Thermodynamic Equilibrium.* **B. P. Gerasimovič.** (Nat. Acad. Sci., Proc. 13. pp. 180–185, April, 1927.)—Saha's theory, on which the theory of stellar spectra rests, assumes that equilibrium between the surface layers of a star and the radiation is complete. Actually this condition will not be rigorously true, since their temperature will be lower than that of the radiation passing through them. A formula is derived, and its relation to Saha's theory is indicated. A. Wh.

LIGHT.

3075. *The Cause of the Colours shown during the Oxidation of Metallic Copper.* **F. H. Constable.** (Roy. Soc., Proc. 115. pp. 570–588, Aug. 2, 1927.)—From the measurements of the intensity of the light reflected from copper oxide films of known thickness it is definitely shown, though the opacity of the film, the dispersion of the oxide and the scattering of the light complementary to the film colour when the metal is burnished complicate the result, that it is interference which causes the production of the colour, and the observations of Hinshelwood [see Abstract 772 (1923)], which are confirmed by the experimental work of the author, are shown to support the interference theory, though Hinshelwood himself, owing to the apparent difficulty of obtaining interference colours in thin films backed by a perfect reflector, has abandoned the interference for the diffraction theory of the formation of colours on steel and copper during oxidation. It is pointed out that Wood's collodion films deposited on bright metallic silver which do not show colours, unless the collodion-air interface be made irregular (*e.g.*, by breathing on it), confirms the interference theory. The behaviour of the collodion is shown to be analogous to that of copper reduced from oxide during activation, for the colours brighten after two or three alternate oxidations and reductions, due to the increasingly fine structure. The partially oxidised copper surface by examination with a microscope of 1250 power is shown to have a granular structure. The order of production of the colours is shown to correspond with the order tabulated by Rollet for the interference colours of air film of increasing thickness seen by transmitted light, and the colours are defined by the thickness of an air film which produces the same colour as the copper oxide film. It is found that the fall in electrical conductivity of the oxidised film supported on china clay is proportional to the equivalent air thickness of the oxide film, and that the equivalent air thickness is approximately proportional to the mass of oxide formed. Full experimental details are given for the production of uniformly activated films and for the production and fixation of the colours. J. K.

3076. *Circular Dichroism of Alkaline Copper Tartrates.* **R. de Mallemann** and **P. Gabiano.** (Comptes Rendus, 185. pp. 350–352, Aug. 1, 1927.)—The Darmois method of polarimetric analysis has recently led one of the present authors [see Abstract 2489 (1927)] to prove the existence of three definite combinations of tartaric acid, copper and alkali. $\mathrm{TCuAmH_2O}$ and $\mathrm{TCuNa.2H_2O}$ were obtained in crystalline form; TCu.2NaOH, on the other hand, decomposed so rapidly in solution that it was not isolated in the earlier experiments. This third substance has now been separated out as a definite compound, $\mathrm{TCuNa_2.2H_2O}$. It is found that all three combinations possess a marked circular dichroism, relatively small in the first two cases but considerable in the case of the di-soda derivative. A. E. G.

3077. *Huyghen's Principle and the Phenomena of Total Reflection.* **C. V. Raman.** (Optical Soc., Trans. 28. 3. pp. 149–158; Disc., 158–160, 1926–1927.)—Owing to confusion in the interpretation of the theory of total reflection when based on the Fresnel formulæ of the electromagnetic theory and on the mechanical theory of light, the author has developed an independent treatment based on physical processes and making no use of the Fresnel formulæ. When light is incident on the boundary of two media and is totally reflected into the first medium, the disturbance in the second medium takes the form of a superficial wave moving parallel to the boundary. The phase difference of the incident and reflected waves are evaluated and also the changes of intensity. The phase advance of the reflected wave relative to the incident wave for light polarised in and perpendicular to the plane of incidence are obtained. For glass this angle is always acute. The results bear out those obtained by Drude on the electromagnetic theory. The source of error in the Kelvin-Schuster treatment is pointed out. Experimental evidence regarding the magnitude of the phase advance of each component separately is in agreement with the classical theory. A method is given by which the distribution of energy, state of polarisation and direction of flow of energy in the superficial wave may be studied experimentally. **T. Smith** raised questions regarding the treatment using light quanta, and their penetration into the second medium. **J. W. Perry** suggested that confirmation might be obtained from the experiments of the existence of a transition layer between two media. R. S. R.

3078. *Diffraction on Black Screens.* **W. v. Ignatowsky.** (Ann. d. Physik, 83. 7. pp. 977–978, Aug. 9, 1927.)—Reply to F. Kottler's criticism [see Abstract 663 (1927)] on the author's paper [see Abstract 78 (1926)]. A. D.

3079. *Electric Double Refraction in Relation to the Optical Anisotropy of Gaseous Molecules.* **A. Bramley.** (Frank. Inst., J. 204. pp. 231–237, Aug., 1927.)—A value for the Kerr constant is deduced from a consideration of the variation of the index of refraction of a gas with electric intensity due, first, to the change in the potential energy of the molecular system arising from the reaction of the electric field on the permanent moment of the molecule, and, secondly, to the dependence of the probability of transition on the relative orientation of the direction of the electric vector in the incident wave, and therefore of the direction of transition with respect to the axis of the permanent moment. The dependence of the probability of transition with direction relative to the polar axis explains the optical anisotropy of the molecular structure in terms of properties of the molecule which arise in the discussion of the spectral properties of the molecule and also the observed phenomena of the depolarisation of the radiation scattered by anisotropic gases. T. M. L.

3080. *Quartz Sub-Standards of the International Metrical Unit of Length. Measurements of their Length and Refractive Indices.* **A. Pérard.** (J. de Physique et le Radium, 8. pp. 344–352, Aug., 1927.)—The six quartz sub-standards ranging in length from 1 to 10 cm. have been measured by two interference methods previously described, at temperatures ranging from 6° to 25° C. The results are expressed by a formula for each quartz which gives the length correct to 0·02 μ or 0·03 μ throughout this temperature interval, allowing for a small uncertainty arising from the fact that the amount of CO_2 in the air of the laboratory, which would affect its refractive index, was not measured. A formula is obtained for the refractive index at different temperatures. H. N. A.

3081. *Double-Quartz Monochromators.* **C. Leiss.** (Zeits. f. Physik, 44. 1–2. pp. 133–138, 1927.)—The advantages and disadvantages of the extant types of apparatus discussed, and a simplified type of fluorite-vacuum-spectrograph described applicable to the Schumann region of radiation. This is far simpler than the original Schumann instrument. A. D.

3082. *Monostatic Twilight Telemetry.* **A. de Gramont.** (Comptes Rendus, 185. pp. 348–350, Aug. 1, 1927.)—In order to test the relative performances of coincidence telemeters and stereoscopic telemeters, the author carried out a series of experiments under carefully regulated conditions of illumination. With this object he constructed a twilight photometer consisting of a so-called daylight electric lamp movable in a vertical chimney about 1 m. in height. By reflection on a transparent mirror placed at an angle of 45° the lamp illuminates a white screen with a circular hole. By means of a horizontal tube provided with an eyepiece the observer sees through the mirror the illuminated screen and, through the central hole, the sky, their brightness being equalised by shifting the lamp in the chimney. The intensity of the lamp is regulated by a rheostat which directs the pointer of the ammeter to a given division. Two closely identical telemeters were used, one for stereoscopic, the other for coincidence, measurements. They differed only in the central prisms, the thicknesses of glass in the coincidence telemeter being 81 mm. and 52 mm. for the right and the left side respectively, and in the stereoscopic telemeter 76 mm. Each apparatus was trained on a mast standing out against the sky at a distance of 2790 m. Starting at dusk and continuing as long as measurements were possible, alternate readings were taken with each instrument and by the same observer. The results, set forth in graphs, show an advantage in favour of the stereoscopic method. E. F.

3083. *The Hartmann Formula for the Dispersion of Glass.* **H. W. Lee.** (Optical Soc., Trans. 28. 3. pp. 161–165; Disc., 165–167, 1927.)—The Hartmann formula is found to be accurate within the limits of the Pulfrich refractometer. A number of glasses are graphed from their Hartmann constants, and it is seen that optical glasses can be divided into three well-marked classes, with linear relations between the constants in each class. AUTHOR.

3084. *Experimental Study of the Best Minimum Wave-Length for Visual Achromatism.* **R. Kingslake.** (Optical Soc., Trans. 28. 4. pp. 173–190; Disc., 190–194, 1927.)—A special telescope is described, in which the chromatic aberration can be varied continuously by means of a zero-power lens sliding within the telescope tube, the conditions being such that this movement does not introduce any other undesirable aberrations. This apparatus has been constructed, and by its aid many determinations have been made as to the best type of achromatism for visual observations, in daylight, in artificial light, and on astronomical objects. Several observers were employed to make settings, and their opinions as to the most desirable type of achromatism are tabulated and compared. In general it is found that a moderate amount of under-correction is needed to give a truly colour-free image, that less under-correction is required if the best definition is to be obtained, and that a slight overcorrection is desirable for astronomical work. AUTHOR.

3085. *Recent Progress in Optics.* **L. C. Martin.** (Roy. Soc. Arts, J. 75. pp. 917–938, Aug. 12; 942–960, Aug. 19, and pp. 965–985, Aug. 26, 1927.)—Among the large range of subjects covered in the three lectures were: (1) optical polish—the necessity for smoothness of surfaces to prevent loss of light in the image, the degree of accuracy needed in mirror and lens surfaces, the views of Beilby, Lord Rayleigh and Preston on polishing action, polishing machines used in the manufacture of lenses and for spherical, ellipsoidal and hyperboloidal surfaces; (2) interference—application of interference methods for the measurements of the angular diameter of stars, types of interferometers and their use to correct faults in prisms and lenses, interferometer tests on microscope objectives; (3) optical design—tolerances allowed for aberration, measurement of aberration in actual lens systems; (4) problems in physiological optics; (5) types of glass now manufactured; and (6) developments in surveying instruments, in photogrammetry, and in microscopy. [See also Abstracts 2575 (1926) and 344 (1927).] R. S. R.

3086. *Deducing the Shape of Luminous Waves from an Examination of the "Shadow Fringes."* **G. B. Pacella.** (Accad. Lincei, Atti, 5. pp. 752–758, May 15, 1927.)—In testing optical systems with diffraction gratings according to Ronchi's method [see Abstract 617 (1927)] the question of the shape of the wave is still unsolved. The effect of the gratings is that the wave emerging from the optical system under examination is decomposed into various identical parts which rotate at a certain angle to each other about the centre of the grating as an axis. The "shadow fringes" reveal the differences of the optical path between given points of two of these diffracted waves. An analytical and a geometrical process are here set forth by which from these differences, deduced from the "shadow fringes," the shape of the wave is determined. Entirely mathematical. E. F.

3087. *Brewster's Bands. Part II.* **S. K. Datta.** (Optical Soc., Trans. 28. 4. pp. 214–217, 1927.)—The paper is a continuation of a previous one [see Abstract 1000 (1926)] under the same title. It discusses the nature of the patterns obtained by the superposition of two systems of Haidinger's rings when the actual law of spacing of the rings is taken into consideration. Figures are reproduced illustrating the patterns, and a theoretical deduction of these is given. AUTHOR.

3088. *Molecular Diffusion of Light in Liquids.* **J. Cabannes.** (J. de Physique et le Radium, 8. pp. 321–335, Aug., 1927.)—Compares the experimental results, including the absolute measurements of the author and Daure, with ether and benzene, and the results of the theoretical formulæ. If the coefficient N in Einstein's corrected formulæ is identified with Avogadro's number, the intensity of the diffused light is too large; in other words, N, which is $6 \cdot 5 \times 10^{23}$ for gases, becomes about 8×10^{23} in all the liquids which have been studied. None of the theories explain this fact. Ramanathan's relation between the depolarisation of light by a vapour and by a liquid, which supposes that the molecules are rigid, does not hold in the fatty series. It is suggested that in the liquid the open chains are deformed and that this diminishes the anisotropy of the molecules. The benzene molecules, on the other hand, are not deformed in the liquid. H. N. A.

3089. *Interferential Microscopic Measurement of Small Particles.* **U. Gerhardt.** (Zeits. f. Physik, 44. 6–7. pp. 397–402, 1927.)—A further development of the method previously described [see Abstracts 981, 982 (1926)]. It was found possible to measure, quickly and with sufficient accuracy, particles of about 150 $m\mu$ in diameter rendered visible in the dark field. The effect is shown in a series of photographs by means of which it is possible to detect differences in diameter of 1 %, measured subjectively. E. F.

3090. *A Modification of Einstein's Theory of Light Diffusion.* **Y. Rocard.** (Comptes Rendus, 185. pp. 497–498, Aug. 29, 1927.)—This short paper is entirely mathematical and does not lend itself to useful abstraction. J. K.

3091. *The Polarisation of Light Quanta.* **P. Jordan.** (Zeits. f. Physik, 44. 4–5. pp. 292–300, 1927.)—In this mathematical paper it is shown that a quantum-mechanical description of the polarisation properties of a single light quantum can be given in a manner formally equivalent to the Pauli theory of magneto-electrons. H. H. Ho.

3092. *Influence of Weak Magnetic Fields on the State of Polarisation of the Light Emitted by Hydrogen Canal Rays.* **H. R. v. Traubenberg** and **S. Levy.** (Zeits. f. Physik, 44. 8. pp. 549–564, 1927.)—The authors discuss their earlier work on this subject and then investigate further the polarisation, depolarisation and rotation of the plane of polarisation produced in weak magnetic fields by the light emitted by canal rays using the series lines H_α and H_β. It was found that (1) with the directions of vision and of the magnetic field coincident and both perpendicular to the canal rays rotation of the plane of polarisation increased with growing fields to a limiting value and depolarisation changed similarly, while the amount of rotation decreases with increase of pressure; (2) with all three directions at right angles no rotation occurs, but polarisation decreases with increasing field strength; (3) with the directions of vision and of the canal rays coincident no polarisation occurs with zero field, but a transverse field causes polarisation; (4) with the directions of the canal rays and field coincident but perpendicular to that for vision no action results; and (5) by a special arrangement of the field a temporary adjustment of the state of polarisation to the field could be observed. The phenomena show an extensive analogy with the state of polarised resonance radiation in weak magnetic fields found by Wood-Ellet and by Hanle, the latter of whom gave an explanation of it. R. S. R.

3093. *Light Scattering of Aqueous Salt Solutions.* **C. W. Sweitzer.** (J. Phys. Chem. 31. pp. 1150–1191, Aug., 1927.)—Aqueous solutions of a wide range of salts were prepared dust-free; their light scattering and depolarisation factors were quantitatively measured. The relative light scatterings calculated from the Einstein-Smoluchowski-Cabannes formula show on the whole good agreement with the observed values. The orientation scattering is approximately proportional to the molar concentration of the salt. The relative scattering of solutions containing two salts is approximately that calculated on the assumption of additivity. Water and salt solutions show fluorescence, largely due to impurities; in acid solutions there is very little fluorescence. The compressibilities and refractive indices of the solutions were measured. A. D.

3094. *General Molecular Theory of Rotatory Power.* **R. de Mallemann.** (Comptes Rendus, 184. pp. 1374–1376, June 7, 1927.)—A brief note outlining a proposed theory to account for the rotatory power of certain crystalline substances. A. B. W.

3095. *The Silver-Sulphide Bromine-Acceptor Hypothesis of Latent Image Formation.* **R. H. Lambert** and **E. P. Wightman.** (Eastman Kodak Co. Research Lab. Comm. No. 312. J. Phys. Chem. 31. pp. 1249–1258, Aug., 1927.)—Hickmann's hypothesis [see Abstract 1346 (1927)] that silver sulphide can act as a bromine acceptor in the formation of the photographic latent image is thermodynamically admissible in its final result, but not in the particular intermediate reactions tentatively suggested by him. Other intermediate reactions are discussed. A. D.

3096. *Theory and Practice of the Carbro Process.* **C. Lighton.** (Phot. J. 67. pp. 362–373, Aug., 1927.)—The Carbro process in its simplest form consists in bringing a wet bromide print into contact with a paper coated with pigmented gelatine soaked in a solution of potassium bichromate, potassium ferricyanide, and potassium bromide. While they are in contact, reactions take place resulting in the formation of an image of hardened gelatine corresponding with the image on the bromide print. In this simplest form the result is not a correct reproduction of the bromide print. The possibility of rendering the reproduction more correct was investigated, and a series of experiments were made, varying the conditions of contact, the concentration of the solutions, and the densities of the bromide print. In order to ensure perfect contact between the bromide print and the soaked gelatine tissue, a special form of squeegee was devised. On the whole the process was able to reproduce the bromide print correctly, but was least satisfactory at the lighter portions. F. J. B.

3097. *Theory and Practice of the Carbro Process.* **C. Lighton.** (Phot. J. 67. pp. 409–420; Disc., 421, Sept., 1927.)—Continuing the work described in a previous paper [see preceding Abstract], the function of each of the various agents used in the Carbro process was determined. The action of the acid in the process is simply the liberation of chromic acid, which reacts much more vigorously than its salts. The use of formaldehyde as a hardening agent, or of other hardening agents, is shown to be unnecessary and undesirable. The second bath was shown to correct the unequal rate at which potassium ferrocyanide bleached the different parts of the silver image. A new type of second bath was developed, which had no other action than the bleaching control. The general theory of the process is explained from the curves of carbros made under different conditions. F. J. B.

3098. *Tests of Photogelatine.* **V. Isajevič.** (Kolloid Zeits. 42. pp. 339–350, Aug., 1927.)—The author submits ten specimens of gelatines from three firms (at Winterthur, Schweinfurt, London) in three grades, distinguished as hard, medium, soft, to about 1000 tests of water content, water adsorption and consequent increase in the strip length, molecular weight, optical rotation, internal friction, power of binding sulphuric acid, reduction of potassium permanganate, electric conductivity and electro-dialysis. The difficulty is that all molecular aggregates of gelatine vary much with the specimen and in the course of time with temperature, etc. In general it might be said that hard gelatines are essentially built up of the original material which has undergone little change, whilst softer gelatines contain much of degraded matter. Solutions of hard gelatine contain fewer dialysable particles of small molecular weight, but more gel-forming particles of large molecular weight. The size of the molecular aggregates varies much with age and conditions; there is no real melting point. The internal friction depends upon temperature, concentration and size of particles. Hard gelatines bind water faster than soft gelatines and have on the whole stronger affinities; but they are attacked more by electro-dialysis, which separates gel and sol and removes the charged organic particles. Classification as to the different properties is difficult, but a general order of merit is proposed. H. B.

3099. *A Novel High-Speed Camera.* **E. B. Wedmore.** (Journ. Sci. Instruments, 4. pp. 345–347, Aug., 1927.)—The principle of construction is similar to that used in the Heape and Grylls camera. All oscillating or jerky motion is avoided by the use of a series of lenses in a rotating disc, which come into action in rotation, travelling at the same rate as the film and passing behind a fixed opening and shutter. In the camera here described the lenses are all focussed for infinity, that is, to receive parallel rays from the object. A circular spectacle lens is then inserted in front of the shutter, being of focal length equal to the distance of the object. An individual lens, with its portion of the film, can be moved in any direction in a fixed plane behind this field lens, and will always pick up parallel rays from any point on the object and focus them on to a corresponding fixed point on the film. By the use of a sufficiently large field lens and shutter, exposure can be continued as long as desired. For the camera lenses proper, single lenses of about 2 in. focal length are used, ground double convex with radii to give minimum spherical aberration, but with no attempt made to correct for other errors. This is made possible by utilising only the central portion of the field. With certain described limitations, it is possible to get useful definition with $f = 2 \cdot 6$. The chief points claimed for this camera are its inexpensive nature and its portability. A. E. G.

3100. *New Arrangement of Siegbahn's Registering Micro-Photometer.* **E. Bäcklin.** (Zeits. Instrumentenk. 47. pp. 373–380, Aug., 1927.)—Particulars are given of the mechanical and experimental details of a new pattern of this instrument designed to give a higher degree of precision in the measurements, and yet to be more compact and easier to handle. The results of tests on plates having a series of ruled parallel lines are reproduced and also of some tests with X-ray emission spectra. [See also Abstract 2404 (1924).] R. S. R.

3101. *Luminescence of Grignard Compounds in Electrical and Magnetic Fields, and Related Electrical Phenomena.* **R. T. Dufford, Dorothy Nightingale and L. W. Gaddum.** (Am. Chem. Soc., J. 49. pp. 1858–1864, Aug., 1927.)—The behaviour of Grignard compounds of the general formula RMg when oxidised in strong magnetic fields was investigated. It was found that strong magnetic fields produced no polarisation in the light from the oxy-luminescence of ether solutions of Grignard compounds, but may affect the brightness. The application of electric fields often caused an unpolarised luminescence at one or both electrodes, which accompanied the electrolysis of the solution. This process was quite distinct from the oxy-luminescence. Preliminary study of the electrode potentials in cells containing ether solutions of Grignard compounds showed that the voltage of such cells was very sensitive to light, and that, following a change in illumination, the voltage might be a periodic function of the time. Reproducible voltages were obtained by employing the flowing junction method. F. J. B.

3102. *Heat of Formation of K_2-Molecules.* **A. Carrelli and P. Pringsheim.** (Zeits. f. Physik, 44. 9–10. pp. 643–652, 1927.)—The brightness of the red band fluorescence excited in potassium vapour by white light is measured and assumed to be proportional to the concentration of the K_2-molecules. Then, either the curve of saturation vapour pressure of K_2 can be plotted and the heat of formation of K_2 calculated therefrom by combination with the known heat of evaporation of the potassium atoms, or it can be determined directly by variation of the temperature under constant pressure. The first method gives 0·63, the second 0·53 volt, while from the convergence frequency of the bands the value is 0·68 volt. The paper contains figures and curves and is partly mathematical. [See also Abstract 2597 (1926).] E. F.

3103. *A New Mass-Spectrograph and the Whole Number Rule.* **F. W. Aston.** (Roy. Soc., Proc. 115. pp. 487–514, Aug. 2, 1927. Bakerian Lecture.)—A description, with fairly complete experimental detail, of recent results obtained with a new mass-spectrograph with a resolving power of about 1 in 600, and an accuracy of 1 in 10,000 when special methods of comparison (use of a modified Poynting Tilting plate arrangement) are used. By means of this instrument the isotopic constitution of mercury has been settled, new isotopes discovered in sulphur and tin (the latter element now being shown to have eleven isotopes), and the two doubtful isotopes of xenon confirmed. Measurements of precision have been made on 51 types of atom contained in eighteen different elements ranging from hydrogen to mercury. The masses of these, accurate to one or two parts in 10,000, are tabulated on the oxygen scale. The relations of Sn and Xe have been re-examined and found not to show the striking abnormality previously suggested. Values for Li^6 and Li^7 are obtained by a recalculation of Costa's results. The packing fractions of the atoms and their percentage divergence from whole numbers expressed in parts per 10,000 are plotted against their mass numbers when it is found that all but light atoms of even atomic number lie roughly on a single curve which descends from hydrogen 77·8 to a minimum of − 9 in the region of bromine. It then ascends again and recrosses the zero line in the region of mercury. The light atoms of even atomic number have packing fractions well below the curve and approximate to a branch rising much less steeply to helium 5·4. The theoretical implications are briefly discussed and it is considered that the results are in keeping with the views of Rutherford, according to whom the nucleus consists of an inner uniform, tightly bound structure, outside which is a looser system of neutrons, protons, and electrons, which is more complex the heavier the element. W. V. M.

3104. *The Light Quantum Theory.* **W. Laschkarew.** (Zeits. f. Physik, 44. 4–5. pp. 359–360, 1927.)—A simple hypothesis explains the reduction of the velocity of light in a material medium. Let the quantum move between two atoms with the velocity c, as in a vacuum. On impact with an atom let it remain for a time t and then proceed in the original direction; this explains the delay. Let l be the mean path of the quantum between two atoms; the time T between its leaving two successive atoms is $T = l/c \cdot + t$; the mean velocity of the quantum is $l/T = c/\{l/c \cdot + t\}$ and the index of refraction is $n = 1 + \{ct/l\}$. Now assume the medium to be moving with velocity v in the direction of the light. Then

$$T = \frac{l}{c - v} + t = \frac{l}{c}\left(n + \frac{v}{c}\right).$$

The path traversed by the quantum in time T is

$$L = \frac{lc}{c - v} + tv = l\left(1 + n\frac{v}{c}\right).$$

The mean velocity of the light is

$$V' = c\frac{1 + n\frac{v}{c}}{n + \frac{v}{c}} = V + v\left(1 - \frac{1}{n^2} + \ldots\right).$$

This agrees with Fresnel's coefficient $(1 - n^{-2})$. A. D.

3105. *Some New Regularities in Atomic Spectra.* **J. C. McLennan** and **A. B. McLay.** (Phil. Mag. 4. pp. 407–413, Aug., 1927.)—Gives a table showing the electron configurations for the normal and for the most easily excited of the higher energy states, where one of the outermost electrons is displaced from an n_2 to an $(n + 1)_1$ orbit, n being 2, 3 . . . . 6 for elements of the 1st, 2nd . . . 5th periods. The spectral terms that should characterise each of these states are given, and in particular the terms which are involved in the production of the most fundamental resonance line. Another table gives the frequencies of the resonance lines of a number of elements, with their term classification. This shows the progression of frequency with atomic number in each period and that it is qualitatively similar in at least each of the first four periods. This is illustrated by graphs, which show a discontinuity in each period between the third and fourth element in the period. It is probable that the n_2 orbits are of two types, n_{21} and n_{22} orbits, with inner quantum numbers $j = \frac{1}{2}$ and $j = \frac{3}{2}$; for the first three elements of a period the n_{21} orbits are more stable, and for the last three the n_{22} orbits. H. N. A.

3106. *Electronic States and Band Spectrum Structure in Diatomic Molecules. Part V. Bands of the Violet CN* ($^2S \rightarrow {}^2S$) *Type.* **R. S. Mulliken.** (Phys. Rev. 30. pp. 138–149, Aug., 1927.)—Theoretical intensity formulæ applicable to bands of the violet CN ($^2S \rightarrow {}^2S$) type are obtained with the help of the summation rules, assuming Hund's case *b* type of interaction of the electron spin. The equations predict two Q branches ($Q_{1,2}$ and $Q_{2,1}$), hitherto unrecognised, which should appear as weak satellite series, one accompanying the familiar double P branch, the other the R branch. These Q branches should decrease in intensity from their first members. The first $Q_{2,1}$ (or $Q_{1,2}$) line should accompany the otherwise single first line of the R (or P) branch, all other P and R lines being truly double; this is in agreement with Hulthén's results on the B bands of CaH. For low *j* values in the P and R branches, the doublet component corresponding to the parallel orientation ($+\epsilon$) of the electron spin vector should be appreciably more intense than that corresponding to the anti-parallel orientation ($-\epsilon$). Treating the doublets (and their satellites) as unresolved single lines, the intensities should be exactly as in $^1S \rightarrow {}^1S$ bands (CuH, HCl). The above predictions seem to be confirmed in the CaH, N_2^+, and violet CN bands. Thus the theory appears to afford a satisfactory explanation of the observed lines and intensity relations in $^2S \rightarrow {}^2S$ bands, removing previous difficulties and uncertainties in interpretation. Other S → S transitions are treated briefly. The nature of the energy differences between the ^2S terms corresponding to $+\epsilon$ and $-\epsilon$ is considered. In all cases where the order of the terms can be determined, with the one exception of the initial states of the B bands of CaH, it is found that $F_1 > F_2$. This suggests that the magnetic field which causes $F_1 \neq F_2$ (developed by the molecular rotation in accordance with Kemble's theory) may be in part that of the nuclei as well as of the electrons. [See also Abstract 2529 (1927).] AUTHOR.

3107. *The Employment of an Incandescent Kathode Vacuum Discharge in Spectroscopy.* **K. L. Wolf.** (Zeits. f. Physik, 44. 3. pp. 170–189, 1927.)—Describes a light source which can be used to obtain the spectra of gases and of metallic vapours. A carbon tube is heated by a current in a vacuum, and forms the incandescent kathode. The anode is a ring of carbon in line with the tube, the light from the interior of which can pass through the hole in the ring to the spectrometer. The light source is free from the defects of the different kinds of arc discharge. The conditions can be kept very constant, and very pure spectra with exceedingly sharp lines can be obtained, so that the method appears suitable for a more accurate determination of the secondary wave-length normals. The increase of line breadth and the shifting of the lines by pressure can be studied, and it is shown that in the case of iron, which has been dealt with in detail, the behaviour of groups of lines in this apparatus and in the arc shows differences, which may be valuable in arranging the lines in multiplets and series. H. N. A.

3108. *Structure of Certain Bands in the Visible Spectrum of Boron Monoxide.* **F. A. Jenkins.** (Nat. Acad. Sci., Proc. 13. pp. 496–503, July, 1927.)—The flame of boron trichloride vapour in active nitrogen has been obtained of sufficient intensity to allow of the bands being photographed with a 21-ft. grating. Attention is here given to the α-bands extending from the red to the near ultra-violet, which have quadruple heads shaded towards the red. A Fortrat diagram shows that in each band there are two origins with four series proceeding from each. The occurrence and form of these branches are discussed. F. S.

3109. *Band Spectrum of Helium.* **W. Weizel and C. Füchtbauer.** (Zeits. f. Physik, 44. 6–7. pp. 431–454, 1927.)—Hitherto the only bands known for the He_2 molecule have not involved vibrations of the nucleus in the initial and final states. New bands have been found in the spectrum of a tube cooled with liquid air which correspond with transitions $0 - 1$ and $1 - 1$. These bands are analysed and the results tabulated. F. S.

3110. *Spectral Intensity Distribution in the Hydrogen Discharge.* **E. W. Tschudi.** (Frank. Inst., J. 204. pp. 219–225, Aug., 1927.)—A discharge-tube is described in which a stream of electrons impinges upon the kathode. Measurements of intensity of the H_γ and H_δ lines were made by a spectrometer with photoelectric cell and electrometer. An increase in intensity of about 20 % was found for each line. F. S.

3111. *Spectral Lines.* **H. C. Burger and P. H. van Cittert.** (Zeits. f. Physik, 44. 1–2. pp. 58–69, 1927.)—The breadth of a spectral line is, in practice, greater than its true breadth as calculated. With the Fabry-Perot interferometer it is possible to determine the true breadth from the apparent breadth. Measurements on the red cadmium line 6439 Å. The true breadth is only slightly larger than the Doppler breadth. The broadening of the line by the apparatus is found to be a little too great; this is attributed to slight defects in the interference plates. A. D.

3112. *Quantitative Sensitivity of Spectral Lines.* **T. Negresco.** (Comptes Rendus, 185. pp. 453–455, Aug. 22, 1927.)—A study of the tables of intensities of lines observed in the analysis of a number of binary alloys leads to a number of conclusions which can be summarised as follows: When the percentage of metal in an alloy is diminished, the intensity of all lines decreases progressively and continuously until they completely disappear. This applies to all lines whatever their nature or origin. The sensitivity of any line depends solely on its intensity in the spectrum of the pure metal obtained under identical conditions. F. S.

3113. *Possibility of Experimental Demonstration of the Displacement to the Red of Resonance Radiation under Repeated Re-Emission.* **S. I. Wawilow.** (Zeits. f. Physik, 44. 6–7. pp. 537–538, 1927.)—Franck showed that the occurrence of emission at the long-wave end of the absorption lines for gigantic stars was explained by the displacement to the red of resonance radiation with repeated absorption and re-emission in rarefied gases. The relation found was $\Delta\lambda = h(1 - \cos\theta)/mc$, where θ is the angle between the absorbed and emitted radiation. For the case where $\theta = \pi$, he found $\Delta\lambda = 1{\cdot}16 \times 10^{-6}$ Å. for Na and $\Delta\lambda = 1{\cdot}33 \times 10^{-7}$ Å. for Hg. Under repeated absorption and re-emission in a rarefied gas the displacement should become measurable spectroscopically. Zemansky showed that the pseudo-phosphorescence of Hg resonance radiation could be photographed for a time 3×10^{-4} sec. This gives a total displacement of 4×10^{-4} Å. for Hg, which should be demonstrable by experiment, while for Na the displacement is nearly ten times larger. R. S. R.

3114. *Broadening of the Hg-Resonance Line in the Presence of Other Gases.* **W. Orthmann** and **P. Pringsheim.** (Zeits. f. Physik, 43. 1–2. pp. 9–15, 1927.)—The resonance radiation in mercury vapour, the absorption lines of which are broadened about 2·5 times the Doppler broadening in contact with other gases, has been excited alternately with "unbroadened" and "broadened" primary radiation. This has no influence on the spectral structure of the resonance radiation, as indicated by measurements of absorption in a mercury-vapour absorption cell. A. B. W.

3115. *Optical Excitation of Mercury with Controlled Radiating States and Forbidden Lines.* **R. W. Wood.** (Phil. Mag. 4. pp. 466–486, Sept., 1927.)—This paper describes further work [see Abstracts 300 and 301 (1926)] on the lines emitted by mercury vapour when subjected to the light from a mercury-vapour arc, with or without filters restricting the spectral range of the exciting radiation. A number of improvements in the technique are first described. The intensity changes following on the introduction of nitrogen into the resonance tube have been investigated and satisfactorily explained by Bohr's theory except in the case of the yellow lines, where further investigation is necessary. Nitrogen has been found to bring about the emission of the forbidden line λ2655·8 ($1S - 2p_3$), and it may cause lines to be developed which are absent when the exciting light is suitably filtered. Certain lines are shown to be decreased in intensity by the admission to the resonance tube of a gas at extremely low pressure. The intensity of the line λ3650 is decreased to a fourth by nitrogen at 0·5-mm. pressure, but as the nitrogen pressure increases the reduction becomes smaller, and finally at 2-mm. pressure has become an increase to twice the intensity *in vacuo*. A considerable number of special points are discussed, and the nature of future work is indicated. W. S. S.

3116. *Structures of the Arc Spectra of Elements of the Oxygen Group.* **J. C. McLennan, A. B. McLay** and **J. H. McLeod.** (Phil. Mag. 4. pp. 486–495, Sept., 1927.)—The lines in the arc spectrum of tellurium in the spectral range λ3200 to λ1640 have been photographed and the intensities, frequencies and, in some cases, term classifications assigned. The spectrum, together with those of Se_1, O_1, and S_1, conforms to the theoretical structure predicted on the Pauli-Heisenberg-Hund theory. The structure for Po_1 remains to be investigated. W. S. S.

3117. *Absorption Spectra of Iron, Cobalt and Nickel.* **W. F. Meggers** and **F. M. Walters, Jr.** (Bureau of Standards, Sci. Papers, No. 551. pp. 205–226, 1927.)—The underwater spark absorption spectra, as well as the ordinary vapour absorptions, have been investigated by others, but not in sufficient detail in connection with the spectral structures of Fe, Co and Ni. Employing high potential condensed sparks between electrodes of iron, cobalt and nickel immersed in water, the underwater spark spectra of these metals were re-examined throughout the visible and ultra-violet regions. The spectrograms show 265 iron lines (2166 to 4404 Å.), 340 cobalt lines (2137 to 4121 Å.), and 225 nickel lines (2124 to 3858 Å.) absorbed in the source. In each case the majority of these are identical with the stronger lines of the arc-emission spectra, and practically all such lines are found to involve either the normal state or some low metastable state of the neutral atoms. These results confirm and extend the known spectral structures for neutral Fe, Co and Ni; the normal states of these atoms are represented by ^{5}D, ^{4}F, and ^{3}F terms, respectively. The type of source used showed most of the metallic spark lines in emission, but certain groups were present in absorption with low intensity. The latter involve low energy states of the ionised atoms; these normal or metastable states are represented by ^{6}D, ^{5}F, and ^{4}F terms for ionised Fe, Co and Ni respectively. AUTHORS.

3118. *The Infra-Red Absorption Spectrum of Liquids.* **E. N. Gapon.** (Zeits. f. Physik, 44. 8. pp. 600–602, 1927.)—Marton has found that in certain organic compounds the frequency of the absorption bands or lines, ν_i, can be expressed by $\nu_i = \nu_c\sqrt{n}$, where n is a series of whole numbers and ν_c is the frequency of the line of longest wave-length. The author shows that theoretically this frequency is given by the equation $\nu_c = 0{\cdot}34 \,.\, 10^{12}\sqrt{\mathrm{V}^{\frac{1}{3}}/M\beta}$, where V is the molecular volume, M the mass of 1 c.c. and β the coefficient of compressibility. Strictly speaking, the values of V and β should be taken at corresponding temperatures, but it is practically more convenient to take them at the same temperature. In the case of nine liquids, good agreement between the calculated and observed values is found in most cases, with fair agreement in the others. H. N. A.

3119. *New Method of Quantitative Analysis Applicable to a Mixture of Rare Earths.* **E. Delauney.** (Comptes Rendus, 185. pp. 354–357, Aug. 1, 1927.)—A study is made of the widening of the absorption bands of elements of the rare earths in the visible spectrum, as a function of the concentration and thickness of the neutral solution inserted upon the luminous bundle. From the results obtained it appears that these spectra obey the law of Beer; the width of an absorption band of a rare element depends solely upon the number of atoms encountered by the incident light. The solution may contain other rare elements. This fact has been utilised to devise a new method of rapid quantitative analysis of a mixture of rare earths and the relative error of the results is less than 1/20. Three experiments are described: (*a*) where the solution contains only one rare element; (*b*) the neutral solution contains two rare elements; (*c*) the solution of a rare earth is acid. A. E. G.

3120. *Absorption and Emission Spectra of Nitric Oxide in Ultra-Violet.* **M. Lambrey.** (Comptes Rendus, 185. pp. 382–384, Aug. 8, 1927.)—NO has always been considered as completely transparent. The existence of an absorption spectrum has, however, now been established, and, owing to the employment of the continuous emission spectrum of hydrogen [see Abstract 2524 (1927)], the fine structure of it has been studied. The method of preparing the gas is described. The spectrum observed of NO appears, with weak dispersion, as a series of very close doublets. With greater dispersion an examination of the two first doublets shows that: (1) Each of the components is really double, (2) the structure is even more complex, (3) each of the components of the doublets is a top of bands. This is indicated not only by the characteristic dissymmetry of the absorption curve, but also by the fact that the bands themselves are visible upon the plates. A. E. G.

3121. *Influence of Magnetic Field on Cadmium Resonance Radiation.* **P. Soleillet.** (Comptes Rendus, 185. pp. 198–199, July 18, 1927.)—MacNair's results [see Abstract 2507 (1927)] relative to the line λ = 3261 Å. have been repeated and extended. At 210° C. the polarisation is 35 %, as he found, but increases to 73 % for 170° C. and below. This applies to a null field obtained by using six flat coils as walls of a cube. When the field is increased to 0·085 gauss the light is completely depolarised. F. S.

3122. *The Superfine Structure of the Terms of the Cadmium Spectrum.* **A. Schrammen.** (Ann. d. Physik, 83. 8. pp. 1161–1199, Aug. 25, 1927.)—The superfine structure of the cadmium lines in the ultra-violet as well as that for the mercury line 2537 have been thoroughly analysed so as to obtain definite data concerning the relationship, if any, between the superfine structure of the terms and the superfine structure of the lines. For this purpose an apparatus is described, having as an essential component a special quartz Lummer plate made by Carl Zeiss. It is shown that these superfine lines of the cadmium spectrum can be expressed by a series of terms resembling in certain features the expressions given by MacNair [see Abstracts 120, 122, 2507 (1927)] obtained by him whilst this work was still in progress. J. K.

3123. *Spectrum of the Sodium Molecule.* **H. Schüler.** (Zeits. f. Physik, 43. 7. pp. 474–479, 1927.)—An interpretation of the yellow-red series of bands observed in a discharge through sodium vapour. It should be considered the resonance series of the sodium molecule which is excited, not externally, but by the Na–D lines of the light source itself. The series is similar to the ultra-violet Lyman-Wittmer H_2 series except that the energy of excitation of the hydrogen band is derived from the first state of excitation of argon, whereas in the case of the sodium molecule excitation is not from an external source but from the sodium atom. The energy of the lowest transition, $2s - p_i$ (D lines) is conveyed to the molecule by collisions of the second type. It is shown in detail how these conceptions enable the structure of the bands to be explained, and it is pointed out that similar considerations may be true for other elements. W. V. M.

3124. *Spark Spectra of Cæsium.* **G. Balasse.** (J. de Physique et le Radium, 8. pp. 311–320, July, 1927.)—An oscillating discharge was sent through the metal prepared in a quartz tube and photographs taken at various explosive distances and at various temperatures up to 240° C. A continuous spectrum was observed, as well as two spark spectra, which could be discriminated by Bloch's method [see Abstract 851 (1924)]. The arc spectrum has been analysed and tables given. Wave-length tables are also given for both spark spectra, and a number of multiplets near to 3200 Å. have been identified corresponding to those of neon and xenon. The measurements agree with those of Shrum, Carter and Fowler. [See Abstract 1398 (1927).] F. S.

3125. *Spark Spectrum of Neon* (*Ne II*). **T. L. de Bruin.** (Zeits. f. Physik, 44. 3. pp. 157–160, 1927.)—The values given by L. and E. Bloch and Déjardin [see Abstract 2353 (1926)] have been analysed and deep quartet terms discovered. It is shown that there is a broad analogy between this spectrum and that of FI previously discussed. [See Abstract 2861 (1926).] F. S.

3126. *The Rotation Spectra of the Hydrogen Halides.* **M. Czerny.** (Zeits. f. Physik, 44. 4–5. pp. 235–255, 1927.)—The paper describes a continuation of the previous work [see Abstract 96 (1926)] on HCl, investigations having now been made on all the hydrogen halides. Detailed descriptions are given of experimental arrangements and devices, and it is shown that the microradiometer has been developed to the limits of its possible sensitivity. As absorption-tube windows, the author has improved on the old lacquer membranes by the use of very thin quartz and paraffin. The latter proves to have a strong absorption for the short-wave radiation but allows the longer waves to pass with little loss. The spectral region previously used (from 40–100 μ) has by this means been extended to 140 μ. The absorption band 4 of HCl at 120 μ has been remeasured and the results of previous investigations confirmed. HBr, NI, and HF have been examined for infra-red absorption for the first time, and it is shown that the rotation spectra of all halides of hydrogen have the same simple structure. The results are expressed in formulæ, the principle terms being determined to an accuracy of 0·1 % for HCl and HBr and 0·3 % for NI and HF. The moments of inertia of the molecules may be calculated to the same accuracy assuming the accuracy of the formulæ, while a comparison of the rotation spectra with the rotation-oscillation spectra gives results in general agreement with the correspondence principle. A general comparison of the results for the various molecules completes the paper. W. V. M.

3127. *The L-Absorption Discontinuities of Silver.* **G. Kellström.** (Zeits. f. Physik, 44. 4–5. pp. 269–278, 1927.)—From the measurements of the diminutions in intensity of the strongest *L*-emission lines for silver, tin and antimony by their passage through a silver foil of suitable thickness the requisite data are obtained allowing the calculation of the L-absorption discontinuities to be made. The results are: $\delta_{L_1} = 3{\cdot}17$, $\delta_{L_2} = 1{\cdot}47$, $\delta_{L_3} = 1{\cdot}25$. The incompleteness of our knowledge on absorption discontinuities is referred to, special emphasis being laid on the uncertainties existing with regard to L-discontinuities in comparison with K-discontinuities. A monochromatic Röntgen ray passing through a homogeneous medium of thickness d is absorbed according to the law $I = I_0 e^{-\mu d}$, I_0 being the intensity at incidence and I at emergence. The diminution in intensity is due to simple absorption and to scattering, so that μ, the diminution in the intensity coefficient, is the sum of the absorption and scattering coefficients ($\mu = \tau + \sigma$). For one and the same medium σ is independent of the wave-length; τ, however, increases rapidly with the wave-length according to the formula $\tau = A\lambda^c$, wherein the exponent C can lie between 2·6 and 3. As the wave-length increases σ can be neglected in comparison with τ. The factor A is constant so long as it refers to the same branch of the absorption curve; a sharp change, however, takes place in passing over an "absorption-peak." The exponent *c* can vary in the same branch of the absorption curve [see Abstract 2070 (1927)]. A graph is given showing the relationship between the absorption coefficient and the wave-length. The present experimental work is based upon (1) the new and convenient method of Jönsson [see Abstracts 1431 and 2079 (1927)], which enables the measurements of the intensity of long wave-length X-rays to be conveniently made, and (2) upon the new method of preparing thin metal foils by kathode sputtering due to Lauch and Ruppert (Phys. Zeits. 27. pp. 452–455, 1926). The apparatus used is described in detail, particular reference being made to the only novelty introduced, a brass tube, descriptive particulars of which are given, which can be placed inside the spectrometer tube and serves as a means for enabling the absorbing silver foil to be introduced or taken out of the path of the X-ray bundle whilst a high vacuum exists in the spectrograph. The experimental results are tabulated, discussed and also compared with the values deduced from theoretical assumptions. The possibility of the silver foil containing holes is also taken into account. J. K.

3128. *New Type of Reflection of X-Rays.* **N. Carrara.** (Accad. Lincei, Atti, 5. pp. 680–683, May 1, 1927.)—Following on previous researches [see Abstract 2980 (1924)], the author now proposes to find the expression of the coefficient of reflection for angles of very small incidence, basing his calculation on the assumption that the reflecting body is a crystal consisting of atoms of one species. Entirely mathematical. E. F.

3129. *Intensity of X-Ray Reflection from Fine Powders.* **J. Brentano.** (Phil. Mag. 4. pp. 620–629, Sept., 1927.)—Discusses results of photometric measurements of powder photograms of sodium chloride very finely powdered. The only extinction effect which can occur is constant for all reflections, but is a function of the wave-length. The conditions necessary to make relative intensity measurement from powders independent of knowledge of the coefficient of absorption and of extinction are indicated. In general the results are in good agreement with those made with single crystals or with coarse powders, but for the most powerful reflections the present measurements give higher values, indicating a small amount of extinction in the measurements on larger crystals. Reduction of a crystal to a coarse powder in general eliminates secondary but not primary extinction. W. H. Ge.

3130. *Continuity Theory of X-Ray Diffraction in Crystals.* **E. Lohr.** (Akad. Wiss. Wien., Ber. 135. 2a. No. 10. pp. 655–674, 1926.)—A mathematical paper not permitting of a short abstract. After dealing with the fundamental equations, the deviations from Bragg's reflection law are determined, and determinations are made of the intensities of the reflected rays. A. B. W.

3131. *Refraction of X-Rays by the Method of Total Reflection.* **R. L. Doan.** (Phil. Mag. 4. pp. 100–112, July, 1927.)—A classical theory of dispersion due to Lorentz and Drude and a quantum theory developed by Kronig [see Abstract 2622 (1926)] exist. The experiments described were undertaken with the object of testing the theory for X-ray dispersion. The method was that of total reflection as used by Nardroff and others from metal films sputtered on glass. For radiating not too close to an absorption edge the Lorentz formula represents the results fairly well. In the one case where a comparative test between the two theories can be made (refraction of MoKα in Ag), the classical theory is in better agreement with the result. The possibility of studying by this method the distribution of electrons receives here additional support.,

J. E.

3132. *Total Reflection of X-Rays and the Index of Refraction of Certain Metals.* **H. W. Edwards.** (Phys. Rev. 30. pp. 91–94, Aug., 1927.)—Total reflection of a beam of X-rays ($\lambda = 0{\cdot}7078$ Å.) is obtained from mirrors of glass, tin, silver, selenium and zinc. The deviations of the reflected rays at the critical positions were measured on photographic films placed 312·5 cm. from the mirrors. The index of refraction was calculated from the measured critical angle in each case, with the following results: crown glass, $\delta \times 10^6 = 1{\cdot}711$; tin, 3·97; silver, 5·78; selenium (vitreous), 2·67; and zinc, 4·59. The experimental values of δ agree with those calculated by the Drude-Lorentz dispersion formula to about 0·5 %. It is shown in the case of the metals that there are undoubtedly in each atom two electrons which have the critical K absorption frequency.

AUTHOR.

3133. *The Compton Effect for Bound Electrons and Some Observations with a Cloud Chamber on Hard X-Rays in Argon.* **F. Kirchner.** (Ann. d. Physik, 83. 7. pp. 969–976, Aug. 9, 1927.)—It is shown experimentally that the photo emission of the second type found by P. Auger [see Abstract 2718 (1925)] in argon may also occur as the result of a Compton scattering process when a fairly tightly bound electron is emitted as a recoil electron. The probability of the scattering process leading to the emission of two electrons is much smaller (8 %) than that of the corresponding absorption process. This is easily understood since the scattering is proportional to the number of electrons, whereas in the absorption the action of the fast-bound K electrons predominates. The K fluorescence for argon for hard rays ($\lambda = 0{\cdot}13$ Å.) is the same as that found by Auger for softer radiations. The photo emission shows a strong asymmetry for $\lambda = 0{\cdot}13$ Å., the mean direction of emission being inclined to the incident direction at an angle of 73°. The distribution of recoil electrons in argon with respect to direction and mean path is described and discussed theoretically.

W. V. M.

3134. *Direct and Indirect Production of Characteristic X-Rays.* **D. L. Webster.** (Nat. Acad. Sci., Proc. 13. pp. 445–456, June, 1927.)—By experiments of two types the author shows that the characteristic rays from silver are largely of direct origin, the experiments of the second type giving a ratio of direct rays to indirect equal to 2·4 at 50 kV, nearly twice the excitation-voltage. The ratio of the indirect radiation to the continuous-spectrum radiation can be calculated reasonably accurately from the known data on the form of the continuous spectrum and the fluorescent energy transformation constant. Indirect rays do not appear notably in spectra from extremely thin targets, especially with light backing-materials for the targets. The ratio of the probability that a kathode ray will remove a K electron from some atom by direct action to the probability that it will radiate a quantum of energy in the continuous spectrum as great as the K-ionisation energy, is of the order of unity for silver at 50 kV. It is probably greater for copper under corresponding conditions and may vary somewhat with voltage. A. B. W.

3135. *Production of X-Rays without a Focus Tube.* **G. Reboul.** (Comptes Rendus, 184. pp. 1436–1438, June 13, 1927.)—In an earlier paper [see Abstract 144 (1927)] the author has shown that a "resistance cell" (of badly conducting material) emits very soft X-radiation, the penetrating power of this radiation increasing with increasing voltage applied to the cell. In the earlier experiments voltages up to 1500 or 2000 volts were employed. With much higher voltages (30,000 to 40,000), however, the author has been able to obtain much more penetrating (short wave-length) radiations using a large number of different substances to form the "resistance cell" (either powdered agglomerates or crystals of rock-salt or alum). Thus a cell of carbonate of copper, under a voltage of 30,000 volts gives radiation capable of penetrating 7 or 8 cm. of air at ordinary pressure and in producing ionisation. These rays are capable, in exposures extending from 20 minutes to 1 or 2 hours, of blackening a photographic plate wrapped in black paper and placed several cm. from the cell. On account of their feeble penetrating power they can be used to radiograph certain objects which ordinary X-rays cannot show the detail: printed characters on paper, thin layers of cardboard, celluloid, mica, aluminium, etc., are silhouetted on the plate after development. An excellent reproduction of such a photograph is given as illustration in the paper. The author predicts the production of X-rays by means of the cell as penetrating as those from a focus tube. A. B. W.

3136. *J-Phenomenon.* **O. Gaertner.** (Phys. Zeits. 28. pp. 493–502, July 15, 1927.)—A useful summary of twenty-nine papers on the Barkla J-phenomenon, together with an account of a failure to repeat the results of one of the experiments. Apparently full details of the apparatus and conditions used are given. W. H. Ge.

3137. *The Atomic Character of Some Properties of X-Rays.* **E. Delauney.** (Comptes Rendus, 185. pp. 193–195, July 18, 1927.)—The author has previously shown that in selective absorption the atomic character is preserved, and that each element in a screen absorbs as if it were alone [see Abstract 2171 (1925)]. He now calculates the intensity of the fluorescent radiations emitted by a mixture, and finds that it is only proportional to the concentrations of the elements when the following two conditions are fulfilled: (1) The wave-lengths of the fluorescent radiations of the two elements are superior to those of the discontinuities; (2) the atomic numbers N_1 and N_2 of the two elements are so near to one another that N_1^3 and N_2^3 can be taken as identical. Experiments have been made with mixtures of $SrCl_2$ and $BaCl_2$, and it was found that the intensity of fluorescence increased much less quickly than the quantity of barium chloride. H. N. A.

3138. *A Simple Radioactive Method for the Photographic Measurement of the Integrated Intensity of X-Ray Spectra.* **W. T. Astbury.** (Roy. Soc., Proc. 115. pp. 640–657, Aug. 2, 1927.)—In this paper a preliminary account is given of a method by which the intensity distribution in X-ray crystal photographs may be estimated by means of a simple and inexpensive apparatus. A photometric arrangement is described in which the negative is replaced by a carbon print and the measurements are carried out by means of α-rays and an α-ray electroscope. This radioactivity photometer is applied to the investigation of the intensity distribution in α-ray crystal photographs. As a preliminary test, the apparatus is used to find the intensity ratio, CuK_α/K_β. In K-ray photographs of the (muscovite) mica cleavage plane it is found that, 1st order : 2nd order : 3rd order = 66 : 31 : 100, and that the intensity ratio CuK_α/K_β is 6·2, when connected for the absorption of the window of the X-ray tube. A further test with a double-wedge photograph of the 3rd order K_α mica line gives still more satisfactory intensity values for the seven steps of the wedge. It is shown how the apparatus may be made to give a curve showing a relation between X-ray intensity and α-ray intensity, which is very approximately linear through the origin. The application of this property to the determination of the integrated intensity of X-ray spectra is discussed and a method outlined. The method of preparation of the carbon prints for the radioactivity photometer is described. A. E. G.

3139. *Röntgen-Ray Apparatus for Crystallographic Research in Chemical Laboratories.* **J. Böhm.** (Kolloid Zeits. 42. pp. 285–287, July, 1927.)—A specially designed apparatus for Röntgen-ray investigations in chemical laboratories is described. The apparatus consists of (1) a source of high tension, (2) a Röntgen-ray tube, and (3) a camera. The Röntgen-ray tube was made by Philips, and consisted of a tube which can be used either as a gas or a luminous kathode. The vacuum is maintained by a Gaede steel diffusion pump, and the window was carried in a chrome steel fitting. The whole apparatus was carried on a stand and formed a self-contained arrangement. F. J. B.

3140. *The Action of X-Rays on Colloids.* **J. A. Crowther** and **J. A. V. Fairbrother.** (Phil. Mag. 4. pp. 325–335, Aug., 1927.)—The investigations described were undertaken to obtain some insight into the mechanism of the action of X-rays on living matter. It was thought that if the action could be explained for some of the simpler inorganic colloids, the more complex problems of organic colloids might later be attacked with more advantage. Hydrosols of the elements, principally metallic, were first employed. The source of radiation was a Shearer tube fitted with a molybdenum antikathode, taking a current of 4 milliamperes at a potential difference of 55,000 volts, supplied by a large induction coil and a mercury break. The rays passed through a thin aluminium window and then through a cover-slip of glass 0·15 mm. thick. The mean value of the mass coefficient in Al of the resulting radiation was 4·6. This corresponds to the absorption coefficient of molybdenum K-radiation. The radiation was measured by an air-gap ionisation chamber, joined to a gold-leaf electrometer and a standard microfarad condenser. It was found that certain colloidal solutions are affected by exposure to large quantities of X-radiation. Positively-charged colloids are coagulated by irradiation, but negatively-charged colloids have their stability increased. The effect was studied numerically for a Bredig copper sol. It is suggested that the coagulation is brought about by the ionisation produced in the diffuse double layer surrounding the particles. J. J. S.

3141. *The Intensities of Soft X-Rays as Dependent on the Voltage.* **A. Jönsson.** (Zeits. f. Physik, 43. 11–12. pp. 845–863, 1927.)—Using the latest Siegbahn high-vacuum spectrograph [see Abstract 757 (1926)], measurements were made of the intensities of the stronger K lines of Al, of some L lines of metals in the Pd group, and some M lines of W and Tl. Voltages up to 20 kV were employed, and the current through the Röntgen tube was from 5 to 10 mA. The intensities are graphed against the voltage and the results compared with the theoretical formulæ of B. Davis [see Abstract 1097 (1918)] and S. Rosseland [see Abstract 687 (1923)]. Davis's formula does not agree with the experiments. Better agreement is obtained with the formula proposed by Rosseland, if the antikathodic absorption is taken into account and the voltage is not too high. Rosseland's expression for the number of ionised atoms in the antikathode does not correspond with the observations. [See also Abstract 1361 (1926).] G. E. A.

3142. *The Dependence of the Total Intensity of X-Radiation on the Current Strength via the X-Ray Tube.* **D. Nasledow** and **P. Scharawsky.** (Phys. Zeits. 28. pp. 549–554, Aug. 1, 1927.)—This paper is largely tabular, with ten curves of variation of ionisation intensity with current strength, for X-ray tubes having targets of copper, palladium, silver, molybdenum and tungsten. Increase of radiation intensity with current only occurs up to certain values and then discontinuities occur, but the resulting variation is still linear. For molybdenum, palladium and silver the discontinuity is at six and for tungsten at eight milliamperes current strength. The position of the discontinuity is independent of the applied tube voltage, but the angle at the discontinuity of the two linear curves varies with the voltage, being smaller at high voltages and quite small at very high voltages. B. J. L.

3143. *Influence of the Discharge Form on the Energy Distribution in the Continuous X-Ray Spectrum.* **D. Nasledow** and **T. Kačura.** (Zeits. f. Physik, 44. 3. pp. 216–222, 1927.)—Previous work by Dauvillier and by Glocker is discussed. The present authors have made ionisation and microphotographic measurements upon two apparatus in which continuous current is produced by means of thermionic valves, one being a composite and the other a "Stabilivolt" apparatus. These were compared with the discharge of an alternator which gives a very peaked voltage curve analogous to an induction coil discharge ("Hartstrahl" machine). It is found that the continuous-current apparatus give an increased X-radiation intensity which is about 1·5 times that of the peaked voltage machine. This result is in agreement with those of previous investigators. B. J. L.

RADIOACTIVITY.

3144. *Charge of α-Rays Emitted Per Second from One Gramme of Radium.* **H. Jedrzejowski.** (Comptes Rendus, 184. pp. 1551–1553, June 20, 1927.)—The mean value of thirteen experiments by the author to determine this fundamental constant gives L = 33·4 e.s.u., which corresponds to a number of N α-particles per second per gram of radium $N = 3 \cdot 50 \times 10^{10}$ in good agreement with the results of the direct counting methods by H. Geiger and A. Werner, Thibaud and L. Meitner. The above value of N is definitely lower than that found by Hess and Lawson, *viz.*, $N = 3 \cdot 72 \times 10^{10}$. A. B. W.

3145. *Recording α- and H-Rays by the New Electrical Method.* **H. Greinacher.** (Zeits. f. Physik, 44. 4–5. pp. 319–325, 1927.)—The new electrical method of the author [see Abstract 1379 (1926)] with purely electronic reinforcement has been used for the oscillographic registration of α- and H-rays. By application of a low-frequency reinforcement and resistance coupling without transformers, the method has been rendered suitable for the ionisation measurements of elementary radiation. The ratio of the ionising powers of α- and H-particles is found to be about $2 \cdot 5$. These records give more exact information as to the inhomogeneity of the instrument indications, which latter have been further investigated by having a single gas (O_2) in the ionisation chamber. Hydrogen gave too small registration effects for the α-particles to be of use for the last-named experiments. H. H. Ho.

3146. *α-Particle Tracks in Thick Layers of Silver Bromide Gelatine Plates.* **L. Myssowsky** and **P. Tschishow.** (Zeits. f. Physik, 44. 6–7. pp. 408–420, 1927.)—Plates were prepared with a layer of emulsion thicker than 50 μ, and were acted on by α-rays from the active deposit of radium on a needle point placed from $0 \cdot 5$ mm. to 2 mm. from the surface of the plate. Most of the tracks appeared under the microscope as a series of points along straight lines. There were also a few tracks with a sudden deviation or break in the line, the angle between the two straight portions being in some cases as much as 90°. Forked tracks were also found. A stereoscopic method was devised for viewing such tracks. It was also found possible, by moving the photographic plate, to obtain a continuous registration of the emission of single α-rays from the needle point.

H. N. A.

3147. *Structure of the Radioactive Atom and Origin of the α-Rays.* **E. Rutherford.** (Phil. Mag. 4. pp. 580–605, Sept., 1927.)—Develops the theory described by the author in the twelfth Guthrie lecture, which supposes that the nuclei of the radioactive atoms contain neutral satellites revolving round a sub-nucleus. A formula is worked out for the energy of the α-particle after its escape from the orbit, and the loss to the sub-nucleus of the two electrons which previously revolved round it in very minute orbits, which were possible owing to the intense field near the sub-nucleus. Values were found by trial for the constants of the formula, and for the quantum numbers assigned to the orbits, which gave very fair agreement between the results of calculation and the energy values obtained experimentally for the kinetic energies of the α-rays from the uranium-radium series of elements. When the same constants were used for the actinium and the thorium series it was possible to find quantum numbers which gave even better agreement with the kinetic energies of the α-rays from these elements. The quantum numbers found were in some cases whole numbers n, and in others differed by $\frac{1}{2}$ from whole numbers. The relation between these quantum numbers and the radioactive constant is worked out, and it is considered possible that a γ-ray may originate in the passage of one of these satellites from one quantum orbit to another. The original paper should be consulted for many interesting details of the new theory. H. N. A.

3148. *Scattering of α-Particles by Helium.* **E. Rutherford** and **J. Chadwick.** (Phil. Mag. 4. pp. 605–620, Sept., 1927.)—The experimental method was similar to that used by Chadwick in measuring the scattering of α-particles by metal foils. Both scattered α-particles, and the He nuclei which are projected by collisions with α-particles reach the zinc sulphide screen, and it is not possible to distinguish between the original α-rays and the projected particles, as can be done in the case of the scattering of α-particles by hydrogen. The number of particles to be expected was calculated from the geometry of the apparatus, and by observation of the number of α-particles scattered by argon under the same conditions. A diagram gives the relation between the ratio between the observed and calculated number of particles between 40° and 50° and the value of $1/E$, where E is the energy of the incident α-particles. The ratio is large for fast particles, drops below unity for slower ones, and then rises again to unity for still slower particles. The results show in general that the collision relations are similar to those between α-particles and H-nuclei. For large distances of collision the forces are given by Coulomb's law, for small distances there are very strong additional forces; it is suggested tentatively that these may be due to magnetic fields in the nuclei. H. N. A.

3149. *β-Rays of High Velocity from Radioactive Bodies.* **D. K. Yovanovitch** and **J. d'Espine.** (J. de Physique et le Radium, 8. pp. 276–283, June, 1927.)—A summary is given of the results of experiments on the rapid β-rays from several radioactive bodies. The method of investigation adopted was generally that of the magnetic spectrum which is a delicate means of detecting such rays, but does not lend itself to obtaining a detailed description of their nature—whether they are continuous bands or groups of rays. By this method quick β-rays from Mesothorium 2 have been revealed, as also from ThB + C, RaB + C and RaE. For these substances the results obtained from the apparatus with direct deviation have been compared with those got by other observers by different methods. The energy attained by certain of these rays, *e.g.* 8×10^6 volts for MsTh.2, is of the same order as that of certain α-rays, *e.g.*, the α-rays from ThC which attain $8 \cdot 825 \times 10^6$ volts. J. J. S.

3150. *The Effect of Radon on the Solubility of Lead Uranate.* **K. C. Bailey.** (Phil. Mag. 4. pp. 404–407, Aug., 1927.)—A. Holmes has suggested that the difference between the estimates of geological time, based on the lead-thorium ratio and the lead-uranium ratio, may be due to the fact that lead uranate is practically insoluble [see Abstract 2038 (1926)]. The author has studied the effect of radon on the solubility of lead uranate, and finds that, under the influence of this gas, the uranate was soluble in a solution of sodium chloride. It results from this that it is doubtful if any differential removal of thorium-lead as compared with uranium-lead can be assumed during geological periods. H. N. A.

HEAT.

3151. *Flow of Heat in a Body Generating Heat.* **J. H. Awbery.** (Phil. Mag. 4. pp. 629–638, Sept., 1927.)—A theoretical paper giving the differential equation with forms of solution for cartesian and for polar coordinates. The special case of a sphere generating heat is solved for temperature at all points and times when the constant initial temperature is given, the surface being held at a definite temperature from a time zero onwards, and also for the more elaborate case where the initial temperature distribution is an equilibrium one, and the boundary condition is Newton's law of cooling. The application of the results to the cold storage of apples is discussed. W. H. GE.

3152. *New Differential Dilatometer for the Determination of Volume Changes during Solidification.* **C. J. Smith.** (Roy. Soc., Proc. 115. pp. 554–570, Aug. 2, 1927.)—A new method devised to give reliable data for change in volume accompanying solidification is described, this volume change being one of the most important factors which govern the production of good castings. This new method is shown to be trustworthy by the results obtained in measuring the volume changes of two eutectic alloys, that of lead and tin which contracts during solidification, and that of tin and bismuth which expands. Previous method of measurement are critically examined, and the theory of the differential dilatometer is mathematically treated; equations are also deduced for the two forms of the instrument used. Full experimental details are given, including references for the preparation of nitrogen, and a full description for the preparation of the metallic eutectics. J. K.

3153. *New Type of Rotating Adiabatic Calorimeter. The Surface Energy and Heat of Solution of Sodium Chloride. Part II.* **S. G. Lipsett, F. M. G. Johnson** and **O. Maass.** (Am. Chem. Soc., J. 49. pp. 1940–1949, Aug., 1927.)—Determinations are made of the heat of solution of coarsely crystalline and of finely divided sodium chloride by a modified type of rotating calorimeter in which contact of the solute with the vapour of the solvent before solution is avoided. Comparative agreement between duplicate experiments are obtained to within 0·05 % for concentrations above 10 %. A calculation is made of the specific heats of the solutions from the temperature coefficients of the heats of solution. From the difference between the heat of solution of the coarse and the finely divided salt, the mean value for the surface energy of solid sodium chloride is calculated to be 386 ergs per sq. cm. at 25° C., which is in close agreement with the value found in an earlier investigation [see Abstract 2096 (1927)]. J. N. P.

3154. *Theory of Gases and the Equation of State. Part II.* **J. Duclaux.** (J. de Physique et le Radium, 8. pp. 336–343, Aug., 1927.)—In Part I the author endeavoured to formulate a theory of gases, using the hypothesis that there is no action at a distance between the molecules, and that these are either completely independent, or are combined chemically, the combinations obeying the general laws of chemical mechanics [see Abstract 611 (1925)]. It was shown that the compressibility and expansion of gases agreed with this theory, and the author now finds that this is also true of the variations of the specific heat with pressure and with temperature. The theory also gives the formula of Sutherland for the viscosity of gases, which is in complete agreement with experiment. It predicts the variations of Sutherland's constant C. From the point of view of this theory the critical temperatures of gases are not in general really corresponding temperatures. H. N. A.

3155. *Vapour Pressures of Solid and Liquid Neon.* **C. A. Crommelin and R. O. Gibson.** (K. Akad. Amsterdam, Proc. 30. 3. pp. 362–364, 1927. Comm. No. 185b from the Phys. Lab., Leiden.)—Determinations are made in a liquid hydrogen cryostat up to 20·4° K., a hydrogen vapour cryostat being used for measurements above the boiling point of H. From a large-scale graph of the results the following values of the triple point constants are found :

$$\Theta = -248\cdot52^\circ\,\text{C.},\ T = 24\cdot57^\circ\,\text{K.},\ p = 32\cdot35\ \text{int. cm.}$$

In one series of measurements a case of supercooling is noted. A. B. C. L.

3156. *A Thermodynamic Treatment of Certain Magnetic Effects. A Proposed Method of Producing Temperatures considerably below 1° Absolute.* **W. F. Giauque.** (Am. Chem. Soc., J. 49. pp. 1864–1870, Aug., 1927.)—The reversible transfer of heat from one temperature to another requires a working substance which is capable of undergoing an isothermal entropy change at the temperatures concerned. It is shown that a magnetic field will produce large effects in entropy change at very low temperatures, and thermodynamic equations are developed in justification. At 1·3° K. a field of 20,000 gauss produces a decrease in entropy of 3·3 cal. per degree per gramme atom of gadolinium, whilst a field of 15,000 gauss produces a decrease of 2·9 cal. per degree at the same temperature. It is therefore suggested that a simple procedure would produce temperatures lower than those obtainable at present, namely: (1) Magnetisation of the working substance whilst it is in thermal contact through gaseous conduction with liquid helium boiling at reduced pressure ; (2) demagnetisation after the space between the working substance and the liquid helium bath has been evacuated. Dysprosium sulphate and gadolinium sulphate are suggested as suitable working substances. The method is applied to experiments on the Bohr magneton number, the explanation of thermal and electrical conductivity, to calorimetry and the determination of heat capacities below 1° K. The analogous case of dipole orientation in an electric field is discussed. S. G. B.

3157. *Paramagnetism and the Third Law of Thermodynamics. Interpretation of the Low-Temperature Magnetic Susceptibility of Gadolinium Sulphate.* **W. F. Giauque.** (Am. Chem. Soc., J. 49. pp. 1870–1877, Aug., 1927.)—The ordinary method of determination of an absolute value of the entropy of a substance by means of the third law of thermodynamics is not applicable to paramagnetic substances and a method is proposed which can be extended to these cases. The measurements of Woltjer and Onnes on gadolinium sulphate are used as the basis of discussion. An expression is deduced, based on orientation without restraint within the solid, for the low-temperature magnetic susceptibility of gadolinium sulphate, and fair quantitative agreement is secured. The theoretical entropy changes accompanying the application of a magnetic field are investigated, and the utilisation of the magnetic formulæ derived is suggested for paramagnetic thermometry and magnetic mixture methods of low-temperature calorimetry. If the entropy of a perfect crystalline substance at the absolute zero of temperature is also zero, the absolute value of the entropy cannot be determined alone from the heat capacity data for substances with positive susceptibility. A method of correction is suggested in certain cases. The paper is illustrated by tables and curves of comparative values. S. G. B.

3158. *Absolute Zero of Entropy and Internal Energy.* **J. E. Verschaffelt.** (Phil. Mag. 4. pp. 335–337, Aug., 1927.)—Criticisms of certain points in the paper of R. D. Kleeman on the properties of substances in the condensed state at the absolute zero of temperature [see Abstract 2337 (1927)]. J. J. S.

3159. *The Rotational Vibration Entropy of Diatomic Gases.* **K. Széll.** (Phys. Zeits. 28. pp. 546–549, Aug. 1, 1927.)—After a brief introductory survey the author enumerates five assumptions on which his work is based: (1) the non-harmonic vibrations of the atomic nucleus in diatomic gases; (2) the assumption of a mean value for the moment of inertia of the molecule; (3) the negligible value of the force of cohesion; (4) the ignoring of the alteration of electron position in the molecule; (5) the condition of excitement of the molecule does not come into the question. The theoretical argument leads to a series of expressions for rotation entropy, vibration entropy at high temperature, and finally for free energy in diatomic gases, as also the simple expression $E_s = RT$ for the vibration energy in this case. S. G. B.

3160. *Classical Mechanics and Thermal Radiation.* **Z. Klemensiewicz.** (Zeits. f. Physik, 44. 4–5. pp. 373–375, 1927.)—The paper is a brief note on the conclusions to be drawn from the experimentally determined laws of heat radiation [see Abstract 411 (1927)]. It is shown that, above all, the general mechanical laws lead to no radiation formula, and that they primarily depend on the choice of special oscillators. S. G. B.

3161. *Determination of the Amount of Radiation from Solid Bodies* **V. Polak.** (Zeits. techn. Physik, 8. 8. pp. 307–312, 1927.)—The necessity for such measurements is established in the case of kettles, ovens, etc. The basis of the measurements is the Stefan-Boltzmann law: $E = \sigma(T_1^4 - T_2^4)$, and from this is derived an expression for the experimental determination of σ. The experimental details are given and follow a previous method due to E. Schmidt. The radiation is measured by a thermoelectric apparatus connected to a galvanometer. The results are given for a series of ovens made of steel, cast iron, wrought iron, silica stone, etc., at high temperatures. There is apparently a strong relationship between the radiation constants of the nature and condition of the outer surface and the temperature of the surface. The agreement between the theoretical and practical results is shown. S. G. B.

SOUND.

3162. *Stationary-Wave Method of Measuring Sound-Absorption at Normal Incidence.* **E. T. Paris.** (Phys. Soc., Proc. 39. pp. 269–295; Disc., 295, June, 1927.)—An apparatus is described for the measurement of sound absorption on specimens of material only 1 or 2 sq. ft. in area. The specimen is fixed by means of a suitable holder at one end of a pipe 30·5 cm. diameter and 226 cm. long, and a constant source of sound placed opposite the other end of the pipe. The whole (source and pipe) is enclosed in a sound-chamber. The presence of the absorptive medium results in " stationary waves " being formed in the pipe, for which the amplitude at the " loops " reaches a minimum instead of zero. The coefficient of absorption is given in terms of the ratio of the pressure amplitudes at the maxima and minima respectively. These are measured by means of a special hot-wire microphone, tuned to the frequency of the source, certain errors being eliminated by a method of comparison with the waves in the same pipe when a practically perfect reflector replaces the absorbent. The source of sound was an oscillator and loud speaker, and details are given as to the method of maintaining its output steady, as also of the effects due to the presence of the microphone in the pipe. Results are given, chiefly for a frequency of 512, but in some cases also for 380 and 650, for a number of materials, mainly acoustic tiles and experimental acoustic plasters. A large effect was noted for one plaster when the thickness was altered. E. G.

3163. *Use of the Electromagnetic Receiver in Acoustical Measurements.* **T. S. Littler.** (Journ. Sci. Instruments, 4. pp. 337–341, Aug., 1927.)—The advantages of the electromagnetic receiver as a microphone in sound measurements are discussed. It is pointed out that the sensitiveness of the moving-coil receiver is much more constant than that of the moving-iron variety, and reasons for this are given. A modification of the usual type of receiver is described, the instrument being rendered sensitive and selective by the use of a tuned electrical circuit, and an arrangement is also given by means of which errors, due to stray electromagnetic disturbances, can be eliminated. The single receiver, so modified, has a high sensitiveness over a frequency range from 200 to 2000, and variations in sensitiveness are not more then 1 %, provided certain precautions are taken. AUTHOR.

3164. *Acoustical Experiments with a Mechanical Vibrator.* **E. Mallett.** (Phys. Soc., Proc. 39. pp. 251–264; Disc., 264–268, June, 1927.)—With the ultimate object of producing a standard source of sound, the author has constructed a mechanically driven organ pipe; a piston attached to a rocking-arm fits the pipe as well as possible, and the rocking-arm is actuated by an eccentric wheel rotated by a larger driving wheel operated by an electric motor. The pipe is open at the other end. The theory of vibrations in a pipe is set out and compared with experimental results. In these, the air-particle velocities were measured by means of a Rayleigh disc, calibrated in a steady air current, evidence being offered that the calibration of this instrument was independent of frequency. The amplitudes were varied by using wheels of the same diameter but varying eccentricity for driving the rocker-arm. The paper contains an appendix, " Critique of Hart's paper on ' The Degradation of Acoustical Energy,' " in which the author claims that Hart's experiments show no real evidence of degradation. In the *Discussion*, **Hart** gives a defence of his position, to which the author replies, claiming that Hart's theory is still unsupported by experimental evidence. E. G.

3165. *The Physical and Biological Effects of High-Frequency Sound Waves of Great Intensity.* **R. W. Wood** and **A. L. Loomis.** (Phil. Mag. 4. pp. 417–436, Sept., 1927.)—The waves were generated in an oil-bath by a piezoelectric oscillator of quartz vibrating at frequencies from 200 to 500 kilocycles per sec. The oscillator circuit is given in a diagram, the usual voltage employed being 50,000 volts. The radiation pressure developed against a glass disc amounted to 150 gm. weight, and was capable of raising the free surface of the oil into a mound 7 cm. high. Maximum effects were obtained with the glass plate when its distance from the quartz was a whole number of half wave-lengths. The presence of stationary waves on tubes was demonstrated by means of a layer of heavy oil on the inside of the tube, which gathered itself into rings about 3 mm. apart as soon as the lower end of the tube was dipped into the vibrating oil. Calculation of the velocity showed that the waves were transverse and not longitudinal. This was verified by the observation that in rods of varying thickness the distance between the rings decreased with the diameter of the rod. The vibrations set up a heating effect which is capable of burning the skin, and the vibrating end of the rod drills a hole through a glass plate when pressed against it. The velocity of the waves in glass rods increases with the frequency and with the diameter of the rod. At 285 kilocycles per sec., the measurements gave 2600 metres/sec. in a rod 6 mm. in diameter, and 400 metres/sec. in a glass thread 0·1 mm. in diameter, the values not being in agreement with the known velocity in glass (about 5000 metres/sec.). A sonic interferometer was developed to measure the velocity in liquids. Observations were also made on the heating of liquids, the internal heating of solids, the formation of emulsions and fogs, the flocculation of suspended particles in a liquid, the effects of the waves on chemical reactions and on crystallisation, and on their biological effects. The method of generation is essentially the one developed by Langevin in 1917 for the detection of submarines. G. E. A.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

3166. *Theory of the Molecular Field.* **R. Ferrier.** (Comptes Rendus, 185. pp. 533–535, Sept. 5, 1927.)—In further considering the problem of determining the electric molecular field the author claims that the incompatibility between theory and observation disappears if we adopt the system of more general equations proposed by him and from which he has deduced certain new consequences by introducing the conception of "free singularities." The treatment is entirely mathematical. [See also Abstract 2111 (1927).] E. F.

3167. *Light Quanta and Maxwell's Equations.* **N. Raschevsky.** (Phil. Mag. 4. pp. 459–466, Sept., 1927.)—N. P. Kasterin's suggestion [see Abstract 1477 (1927)] that the form of the light-quantum hypothesis, proposed by J. J. Thomson, may be obtained by admitting discontinuous solutions of Maxwell's equations is examined. It is pointed out that since we can observe electricity and magnetism only by means of the electromagnetic field produced, Kasterin's discontinuous solutions representing ring quanta are observationally equivalent to certain distributions of moving electric charge. The incompatibility of the light-quantum conception and Maxwell's equations has, however, not yet been established, and Schrödinger's recent suggestion that the charge of an electron in the lower quantum states may be spread over a widely extended region, introduces the possibility of highly asymmetric waves obeying Maxwell's equations, yet having, maybe, properties similar to those of light quanta. W. S. S.

3168. *Electronic Gyration.* **P. Drumaux.** (Ann. Soc. Sci. de Bruxelles, 47. pp. 101–108, Aug., 1927.)—The author proposes to establish, by a comparatively simple calculation, the value of the ratio between the magnetic momentum and the momentum resulting from the quantities of motion of a gyrating electron, on the hypothesis of a spherical electron having a uniform volume charge. Entirely mathematical. E. F.

3169. *Waterfall Electric Action on Solutions of a One-Value Electrolyte.* **A. Bühl.** (Ann. d. Physik, 83. 8. pp. 1207–1224, Aug. 25, 1927.)—In this paper the quantity of carriers of electricity generated in air by the scattering of solutions in water of HCl, KCl, NaCl, LiCl, KOH, NaOH and LiOH, in dependence on the concentration and the disruption velocity, is investigated. The experimental results are made use of to modify the ideas on the build of the surface layers and on what happens in these layers as first given by Lenard. [See also Abstract 1702 (1925).] A. E. G.

3170. *The Negative Charge of the Earth.* **W. Anderson.** (Zeits. f. Physik, 44. 4–5. pp. 376–384, 1927.)—The "lightning-flash" hypothesis is subjected to exhaustive criticism, and it is concluded that it cannot be vindicated. The hypothesis of the earth's bombardment by an extreme β-radiation is apparently untenable, as is also T. Schlomka's "influence" hypothesis. The author seeks to vindicate, and believes, that only the hypothesis of "the spontaneous proton destruction" can be accepted, but certainly not in the form in which it is enunciated by W. F. G. Swann.

S. G. B.

DISCHARGE AND OSCILLATIONS.

3171. *Motion of Striæ in Discharge Tubes.* **L. H. Dawson.** (Phys. Rev. 30. pp. 119–123, Aug., 1927.)—Curves of the variation with pressure of the position of the striæ of the positive column of a discharge tube have been obtained for tubes of 16, 34 and 80 mm. diameter with hydrogen, helium, nitrogen, air, carbon monoxide, carbon dioxide and oxygen for pressures of 0·8 to 0·05 mm. of mercury. As the pressure is reduced the striæ move away from the kathode. The magnitude of the shift for a given pressure change increases rapidly with the diameter of the tube. For the 80 mm. tube it is about 10 cm. for a pressure change of 0·1 mm. Such a discharge tube may be used as a sensitive and quickly responding pressure gauge. The shift of the striæ is unaffected by variation of the distance between electrodes, or by variation in the current up to 10 milliamperes. On the other hand, increasing the current from 10 to 30 milliamperes shifts the striæ about 1 cm. towards the anode. Curves are presented showing the variation in length of the kathode dark space in H_2, He, N_2, CO, O_2, CO_2, and air with pressures from about 0·07 to 0·8 mm. The increase in length is of the order of 1 cm. for a decrease of pressure of 0·1 mm. in H_2 and He, and about half that amount for the other gases. The change in length is not greatly affected by the diameter of the tube, shape of the electrodes, or current up to 10 milliamperes.

AUTHOR.

3172. *Pressures in Discharge Tubes.* **W. H. Crew** and **E. O. Hulburt.** (Phys. Rev. 30. pp. 124–137, Aug., 1927. Paper read before the Nat. Acad. Sci.)—The increase of pressure of a gas in a discharge tube due to the electric discharge has been measured for pressures from about 0·1 to 20 mm. Hg for He, H_2, O_2, N_2, air, CO and CO_2. The pressure increase is regarded as due chiefly to (1) the increase of temperature of the gas, and (2) the dissociation of the molecules of the gas into atoms or less complex molecules, and has been used to determine the temperature and the dissociation. Pressures below 1 mm. were measured by a striation gauge, the shift of the striations giving the pressure, and pressures from 2 to 20 mm. by an oil manometer. For moist hydrogen it was found that γ, the atomic concentration, *i.e.*, the number of atoms divided by the total number of atoms plus molecules, increased rapidly with the power to a certain limit and was then appreciably constant. With dry H_2 γ was less. The atomic concentrations were in exact accord with spectroscopic inferences. For O_2 γ rose to 60 % for pressures below 0·25 mm. For N_2, CO and CO_2 γ was practically zero. Air acts like a mixture of N_2 and O_2. The conclusions were based on the assumption that few complex molecules were formed such as H_3, O_3, N_3, etc. The results for pressures above 2 mm. were unreliable to determine γ because of the uncertain temperature corrections. A new striation phenomenon with condensed discharges is described and photographs of it reproduced for pressures of 4, 6 and 8 mm. R. S. R.

3173. *Hydraulic Model of the Electric Discharge.* **W. Cramp.** (Engineering, 124. p. 314, Sept. 2, 1927. Paper read before the British Assoc., Leeds, Sept., 1927.)—A model is described in which current is represented by fluid velocity, self-induction by mass, and capacity by a surge pipe. This model is fed by a continuous stream of fluid, and so arranged that, when the pressure in the surge pipe reaches a certain value, a valve automatically opens and allows it to discharge. This valve automatically closes when the discharge pressure falls to a predetermined figure, so that the cycle can repeat. Difficulty was found in devising a reliable and sensitive valve. A satisfactory and simple device consists of a wet taper tube fitted as the outlet of the syphon, and hung vertically with its larger end downwards; this forms an automatic meniscus valve. A diagram of the apparatus is given with a full description of the method of using it. A note on the oscillation time of the model is appended. A. E. G.

3174. *The Discharge of Canal Rays.* **J. Koenigsberger.** (Zeits. f. Physik, 43. 11–12. pp. 883–898, 1927.)—Discharge measurements for canal rays which traverse a path between nearly approaching walls of metal and exhibit in consequence the action of the metal surface were quantitatively established for small wave-lengths of the positive and neutral hydrogen atom radiation. On this account the wave-lengths measured by Wien and Rüchardt in constricted condensers are smaller than those found by Rüttenauer in a freer path in air. Further, it is explained why in the researches of Rüttenauer and Rüchardt the wave-lengths are apparently not proportional to the pressure. Rüttenauer's values for the wave-length of H_1 in H_2, H and H_2 in O_2, O in O_2, Hg in H_2, were recalculated with the help of Rüchardt's improved correction formula and with more accurate consideration of the scattering. J. J. S.

3175. *Relation between Temperature and Work Function in Thermionic Emission.* **A. K. Brewer.** (Nat. Acad. Sci., Proc. 13. pp. 592–596, Aug., 1927.)—It was shown recently [see Abstract 246 (1927)] that some sorts of ionisation accompanying chemical action not only followed the Richardson equation, but possessed such other properties in common with thermionic emission as to suggest that they might be looked upon as special cases of the latter. Under the conditions in which ions were formed at a surface only when chemical action was taking place, distinct relationship was shown to exist between the difference in temperature of emission of the positive and negative ions (∂T), and the difference in their work function (∂b) as determined by the usual treatment of an equation of the Richardson form. It is the purpose of the present paper to show that an interdependence also exists between ∂T and ∂b for the positive and negative thermionic currents from a given surface in the presence of various gases. If the interpretation of the phenomena as given here is correct it ought to be possible to make direct determinations of the contact potential which must change sign as ∂T and ∂b pass through zero. Further experiments are in progress. A. E. G.

3176. *Electrical Properties and Nature of Active Nitrogen.* **P. A. Constantinides.** (Phys. Rev. 30. pp. 95–108, Aug., 1927.)—Glowing active nitrogen from an electrodeless discharge tube was drawn in succession through two sets of coaxial cylindrical electrodes. The current between the electrodes of the second set was found to remain constant when the potential between the electrodes of the first set was varied from 0 to 250 volts. This indicates that the conductivity is not due to ions drawn from the discharge chamber. By varying the ratio of the areas of the second set of electrodes it was established that the saturation currents were proportional to the area of the negative electrode. It is concluded that the current between electrodes in active nitrogen is due to electrons emitted from the surfaces of the electrodes either photoelectrically or by direct action of the active nitrogen on the metal. The form of the current-potential curves indicates that the electrons are emitted with relatively high velocities. Helium did not affect the afterglow up to pressures ten times that of the nitrogen, whereas N_2, H_2 and O_2 shortened the afterglow in the order named. It was found that active nitrogen did not ionise hydrogen or mercury vapour. Indications of ionisation of iodine vapour were obtained. This suggests that the molecule of active nitrogen is N_2 in a metastable state with energy between 9·4 and 10·4 volts. AUTHOR.

3177. *Ionisation in Hydrogen and Nitrogen.* **H. Kallmann** and **M. A. Bredig.** (Zeits. f. Physik, 43. 1–2. pp. 16–26, 1927.)—Further investigations have been made [see Abstract 592 (1926)] on the formation of hydrogen-atom ions by means of slow electrons. More extensive measurements are described on the apparent masses H and N_1.
A. B. W.

3178. *Ionisation in Hydrogen, Nitrogen and Argon.* **K. E. Dorsch** and **H. Kallmann.** (Zeits. f. Physik, 44. 8. pp. 565–574, 1927.)—The ionisation potentials of hydrogen, nitrogen and argon have been compared. If the ionisation potential of argon (from optical data) is taken as 15·6 volts, it follows from the present research that for nitrogen the value lies between 16 and 16·5 volts and for hydrogen about 16·5 volts. [See also preceding Abstract.] A. B. W.

3179. *Total Ionisation Due to Absorption in Air of Slow Kathode Rays.* **J. F. Lehmann** and **T. H. Osgood.** (Roy. Soc., Proc. 115. pp. 609–624, Aug. 2, 1927.)—The object of the experiments here described is to measure the average ionisation produced by the absorption in air of an electron with definite initial energy. From this the average expenditure of energy associated with the formation of a pair of ions can be estimated. Homogeneous beams of slow kathode rays are introduced into an ionisation chamber. The kinetic energy of the electrons is absorbed by the air in the chamber and the resulting ionisation is measured. The ratio of ionisation current to electron current gives the average number of ions produced by the absorption of each electron. The electrons can be given any desired initial energy within the range 200 to 1000 electron-volts. The average ionisation per electron, for complete absorption, is found to be proportional to the initial energy of the electrons. The average energy expended in the formation of a pair of ions is found to be 45 electron-volts in air. The range of the electron beams is also measured. Further discussion of the measurements in air is postponed until they can be correlated with the corresponding measurements in other gases. [See next Abstract.] A. E. G.

3180. *Absorption of Slow Kathode Rays in Various Gases.* **J. F. Lehmann.** (Roy. Soc., Proc. 115. pp. 624–639, Aug. 2, 1927.)—The total ionisation due to the absorption of homogeneous beams of slow kathode rays is measured in helium, argon, hydrogen, nitrogen, and carbon dioxide. The average ionisation per electron for complete absorption is proportional to the initial energy of the kathode ray. The average energy expended in the formation of a pair of ions and the efficiency of ionisation are as follows:—

	Energy per Ion Pair.	Efficiency.
Helium	31 electron-volts	0·78
Argon	33 ,, ,,	0·46
Hydrogen	37 ,, ,,	0·43
Nitrogen	45 ,, ,,	0·38
Carbon dioxide	45 ,, ,,	0·32

The rate of absorption of electronic energy necessary to correlate the present measurements of total ionisation with the measurements of Compton and van Voorhis and of Kossel on ionisation per unit path is estimated. The range of kathode rays, in air, is estimated (1) from the pressure necessary to absorb the rays within the length of the ionisation chamber, (2) from the rate of absorption of electronic energy. The two estimates are found to be concordant. [See preceding Abstract.] A. E. G.

3181. *Ionisation by Collision.* **J. Taylor.** (Phil. Mag. 4. pp. 505–511, Sept., 1927.)—In this paper a reply is given to Huxley's criticism [see Abstract 2375 (1927)] of a "photoelectric theory" of sparking potentials previously put forward by Taylor [see Abstract 1849 (1927)]. It is pointed out that there are serious objections to Townsend's theory and that the photoelectric theory arose from a hypothesis of J. J. Thomson's, according to which positive ions liberate photoelectrons by the action of the radiation emitted when they are neutralised at the kathode surface. The Townsend theory fails to account for the effect on the sparking potentials of the nature and condition of the electrodes, whereas the photoelectric theory does give an explanation of such effects. Further experiments are in progress which will throw light on the validity and value of the photoelectric theory. A. W.

3182. *Ionisation Efficiency of Ultra-Violet Light in Cæsium Vapour.* **E. M. Little.** (Phys. Rev. 30. pp. 109–118, Aug., 1927.)—Light from a quartz mercury arc after being resolved by a quartz spectrograph was passed through a tube containing cæsium vapour. The energy of the radiation was measured with a Coblentz thermopile. The photo-ionisation of the vapour was determined by drawing out the positive ions to a plate and measuring their number with an electrometer. The vapour pressure of the cæsium was obtained by interpolation between existing data. The pressure at 166° C. was taken as 0·027 mm., which corresponded to an atomic concentration of $5\cdot96 \times 10^{14}$ atoms per c.c. The efficiency of ionisation B (the Einstein probability of absorption coefficient) was found to increase from $0 \cdot 17 \times 10^{-10}$ ions per atom per erg at 3345 Å. to $3 \cdot 4 \times 10^{-10}$ at 3135 Å. The theoretical threshold is at 3184 Å. For shorter wave-lengths B diminished to a minimum of $1 \cdot 2 \times 10^{-10}$ at 2800 Å. and then increased slowly for still shorter wave-lengths. The estimated possible error in B is 5 % in relative values and 25 % in absolute values. It was incidentally observed that cæsium alloyed readily with a gold electrode and that the resulting surface was very active photoelectrically. The photo-sensitivity varied from $0 \cdot 5 \times 10^8$ electrons per erg at 6100 Å. to $2 \cdot 0 \times 10^8$ at 2800 Å. AUTHOR.

3183. *The Exit Work of Thermo-Electrons.* **G. Michel.** (Zeits. f. Physik, 44. 6–7. pp. 403–407, 1927.)—Assuming that the atoms of a metal carry positive charges at regular distances b over the emitting surface, the author arrives theoretically at the formula $\Delta\phi b^2 = C$, where $\Delta\phi$ is the exit work in volts and C is constant for a group such as the alkaline earths. Tables are given giving the values of $\Delta\phi$, which show that this relation holds with fair accuracy for the oxides of the second group, Be, Mg, Ca, Sr and Ba; of the third group, B, Al, Sc and Y, and of the fourth group, Si, Ti, Zr and Th. H. N. A.

3184. *Space-Distribution of Photoelectrons Ejected by X-Rays.* **E. C. Watson.** (Nat. Acad. Sci., Proc. 13. pp. 584–588, Aug., 1927.)—The experiments of Wilson, Auger, Bothe, Bubb, Loughridge, and Kirchner by the C. T. R. Wilson cloud expansion-chamber method have shown that while the most probable direction of the photoelectron tracks in a gas traversed by X-rays is nearly the direction of the electric vector of the incident radiation, there is apparently a very considerable "spread" in the direction of the tracks. Magnetic spectra of the electrons ejected from very thin metallic films at various angles show similar effects. Theories to account for this apparent emission from the atom over a wide range of angles instead of in one definite direction have been given by Bubb, Bothe, Auger and Perrin, Wentzel and Beck, but none of them is satisfactory in explaining all the known experimental facts. As the result of the present work it is concluded that the theory of nuclear scattering, together with the assumption that the electrons all start from the parent atom in the same direction, explains in a satisfactory way all the details of the observed space-distribution of the photoelectrons ejected by X-rays. A. E. G.

3185. *Variation of the Velocity Distribution of Photoelectric Electrons by Degassing and Gas Charging Process in Palladium and Platinum.* **W. Bennewitz.** (Ann. d. Physik, 83. 7. pp. 913–940, Aug. 9, 1927.)—The photoelectric sensitivity of palladium and platinum foils is varied within wide limits by means of degassing and charging with gas, and the velocity distribution of the emitted electrons is obtained for each condition. There appears to be, from a qualitative point of view, a general parallelism on all sides between the alteration of photoelectric power of emission, the maximum first energy, the mean volt velocity, the contact p.d., and the long-wave limit. The results obtained are in good agreement with the Einstein equation. The velocity which is approximately reached in the maximum number of emitted electrons for every series of experiments is equally removed from the maximum velocity. With palladium two maxima can be distinguished in the velocity distribution curve, of which one predominates only at smaller sensitivity and the other always comes forth more clearly with increase of sensitivity. With platinum, on the other hand, only a slight displacement of the maximum to the side of maximum velocity occurs with increasing sensitivity. A method is given which enables the temporary influence of alteration of photoelectric sensitivity on the velocity distribution to be shown in a simple manner. A useful list of papers bearing on the subject is appended. A. E. G.

3186. *Electron Velocities of the Normal and the Selective Photoelectric Effects.* **F. Wolf.** (Ann. d. Physik, 83. 7. pp. 1001–1053, Aug. 9, 1927.)—The velocities of the electrons liberated by wave-lengths 546, 436, 405, and 365 $\mu\mu$ from a mercury arc were determined by the method of deviation in a homogenous magnetic field, the volt-velocities of the electrons at the maximum of the distribution-curve being measured and not those of the fastest electrons. The velocities for the selective effect, which is produced when the electrical vector of the incident polarised light lies in the plane of incidence, and for the normal effect when it is at right ahgles to this plane, are essentially identical. The relation of the velocity to the frequency of the light is the same for the two effects. Some secondary differences are noted. H. N. A.

3187. *The Influence of Water of Crystallisation on the Photo Effect in Crystal Hydrates. Part II.* **A. Predwoditelew** and **W. Blinow.** (Zeits. f. Physik, 44. 3. pp. 207–215, 1927.)—In this paper it is shown that each molecule of water of crystallisation in the crystal hydrates $CuSO_4 . 5H_2O$, $AlK(SO_4)_2 . 12H_2O$, $MnSO_4 . 7H_2O$, does not exert the same effect on the photoelectric activity as would be expected on the Werner theory. With copper sulphate the photo effect is increased by the first (to be combined) water molecule, and $CuSO_4 . H_2O$ is found to be 5·75 times more active than the anhydrous substance. For aluminium-alum the acceptance of one molecule of water by $4AlK(SO_4)_2 . H_2O$ to form $2AlK(SO_4)_2 . H_2O$ results in an eightfold increase of photo effect. Manganese sulphate appears to form three crystal hydrates: $4MnSO_4 . H_2O$, $2MnSO_4 . H_2O$, $MnSO_4 . H_2O$, of which the first is 4·25 times more active than the anhydrous substance, and the second and third are 1·8 and 2·6 times less active respectively. H. H. Ho.

3188. *A Thermionic Balance.* **A. lo Surdo.** (Accad. Lincei, Atti, 5. pp. 813–818, June 1, 1927.)—In this balance one arm consists of two rectifying thermionic valves arranged in series in a circuit in which acts a constant e.m.f., and so arranged as to allow the passage of the current; the plate of one valve is connected with the positive pole of a battery, and the filament with the plate of the other valve, the filament of which is connected to the negative pole. The theory of the arrangement is discussed and diagrams showing three different balance methods are given. A. E. G.

3189. *The Valve Filament at Constant Voltage.* **E. H. W. Banner.** (Journ. Sci. Instruments, 4. pp. 317–324, July, and pp. 349–356, Aug., 1927.)—This paper shows that for standard tests on valves, except those valves intended for use without a rheostat, the ordinary methods of connection are not accurate. If, when a filament voltage is specified, the actual test circuit used is also stated, it is possible to compare results, but for accurate work the network described should be used. As the position of the return lead is not constant for different valves, a sliding or other adjustable potential divider should be used, the total resistance being of the order of 100 to 1000 Ω. In inserting a valve and adjusting to about normal voltage the anode should be connected and the slider moved whilst switching on and off the anode voltage, until no alteration of the filament voltmeter reading occurs. For that type of the valve the test-table is then correctly set, and readings may be repeated easily by maintaining this voltmeter reading constant by means of the filament rheostat. It is considered that it would be informative if valve manufacturers or testing institutions could test large batches of similar valves run on similar conditions of load, but with d.c. and a.c. filament heating, to find how far the theoretical weakness of the negative end of a d.c. heated filament is true. Evidence of the prolongation of life when run on d.c. by periodically reversing the polarity is also wanted. A. E. G.

3190. *Hysteresis in Vacuum Tube Oscillators.* **L. S. Taylor.** (Frank. Inst., J. 204. pp. 227–230, Aug., 1927.)—In an earlier investigation [see Abstract 2131 (1927)] it was shown how, when a blocking condenser and resistance were placed in the grid circuit of a vacuum tube oscillator, the oscillations were broken up into groups which were for convenience called "zules." It was pointed out that such a circuit was capable of operation in two states, namely, one of continuous and one of intermittent oscillation. The actual state of oscillation is determined chiefly by the constants of the oscillatory circuit in which oscillation is maintained by the vacuum tube. Use is made here of a synchronised kathode-ray oscilloscope with a linear time axis, by means of which the theory could be checked. Two assumptions had been made: (1) That the circuit when oscillating in the intermittent state did not suffer any appreciable wave-distortion within the zule; (2) that the oscillation frequency within the zule remained constant. When the wave is observed by means of the oscilloscope both these assumptions are found to be true. Diagrams are given in which the hysteresis action taking place as caused by the grid depression is strikingly shown. A. E. G.

3191. *Stationary Waves and Oscillating Discharges.* **W. Rogowski, E. Flegler** and **R. Tamm.** (Archiv f. Elektrot. 18. pp. 479–512, June 27, 1927.)—The paper comprises an oscillographic study of numerous forms of oscillatory discharge, high-voltage and high-frequency. A kathode-ray oscillograph is employed. [See also Abstract 2143 (1925).] A. B. W.

3192. *Control of the Frequency of Flashing of a Neon Tube by a Maintained Mechanical Vibrator.* **W. A. Leyshon.** (Phil. Mag. 4. pp. 305–324, Aug., 1927.)—A theoretical and experimental investigation was made into the action of a tuning fork for holding constant the frequency of flashing of a neon tube. It was shown that the action could be considered as the result of the introduction of a sinusoidal voltage of constant frequency and variable phase into the neon-tube circuit, this voltage being introduced electromagnetically into the circuit by the motion of the prongs of the fork, and the phase of this voltage adjusting itself so that the frequency of flashing is equal to the frequency of vibration of the fork. The theory was found to be applicable to the case of vibrators maintained electrostatically, *e.g.*, piezoelectric crystals in parallel with the condenser. The essential characteristics of the electrical vibrations of the neon tube are that the voltage amplitude is constant, and that the periodic time is dependent on the "time constant" of the circuit and the constant voltage applied to the circuit. The periodic time is practically equal to the time of charging the condenser. F. J. B.

3193. *Spark Constant, Impulse Voltage and Travelling Wave Front.* **H. Müller.** (Archiv f. Elektrot. 18. pp. 328–339, June 10, 1927.)—The author describes a series of experiments directed towards determining whether Toepler's spark constant needs a general correction or whether it is a function of the circumstances of the experiment. It is concluded that the latter is the case. The basic equations for the calculation of impulse voltage and wave-front values are stated, and the test circuits, methods and results are explained. Curves are given showing the spark constant as a function of the travelling wave voltage, the wave resistance of the line, and the supplementary control system. Once the transient is initiated, the subsequent course of events is affected by the constants of the circuit carrying the charges. R. E. N.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

3194. *Electrical Conductivity at Low Temperatures.* **J. C. McLennan** and **C. D. Niven.** (Phil. Mag. 4. pp. 386–404, Aug., 1927.)—Resistance measurements were made at room-temperature and at the temperatures of liquid air, liquid hydrogen and liquid helium on a number of substances to obtain the resistance-temperature curves and thus obtain evidence of superconductivity at low temperatures. For Pb superconductivity was found at 7·5° K., against Onnes' value of 7·2° K. Cd acquired a constant resistance below 8° K. with a value in good agreement with that found by Meissner, while ageing had a considerable effect. It was found to be superconducting at 3·38° K., against Onnes' value of 3·42° K. Other substances found to be not superconducting were Na, K, Be, Rb, Cr, and Th. R. S. R.

3195. *New Electron Theories.* **E. Kretschmann.** (Phys. Zeits. 28. pp. 565–592, Aug. 15, 1927.—A critical review and summary of new electron theories relating to the conduction of electricity and of heat in metals. J. J. S.

3196. *Investigation of Metallic Crystals. Part V. Conduction of Heat and Electricity by Mono- and Polycrystalline Metals of the Regular System.* **E. Grüneisen** and **E. Goens.** (Zeits. f. Physik, 44. 9–10, pp. 615–642, 1927. From the Reichsanstalt.)—A large number of test pieces of Au, Pt, Cu, W, Rh, Al and Fe were studied, the electrical and thermal resistance being measured at low temperatures down to − 252° C. The lower the temperature the more the thermal resistance of good conductors depends on the degree of purity and the mechanical treatment. No effect of the size of the crystallites could be clearly proved. Specimens of the same metal, which differ in purity or in hardness, have specific thermal resistances, *w*, at the same temperature, which are a linear function of their specific electrical resistances. This holds for moderate degrees of impurity. These straight lines cut the thermal resistance axis at points above the zero point, and it is assumed that the intercept above the zero gives the non-metallic specific thermal resistance of the metal, w_i, which does not depend on its purity, etc., for the particular temperature involved. If this is subtracted from the measured w of any specimen it gives the metallic specific thermal resistance, w_m, which is equal to ρ/ZT, where ρ is the specific electrical resistance and T is the absolute temperature. w_m obeys the Wiedemann-Franz-Lorenz law. At low temperatures Z is nearly independent of the nature of the metal and of the temperature; w_i depends on the temperature, and the relation between them is discussed. H. N. A.

3197. *The Dependence on Temperature of the Photoelectric Primary Current in Diamond.* **H. Lenz.** (Ann. d. Physik, 83. 7. pp. 941–955, Aug. 9, 1927.)—The substitution primary current measured with light decomposed into a spectrum shows itself to be in the diamond almost independent of temperature. The reason for the strong falling-off of the stationary primary current with temperature is not to be sought in a spectral shifting of the optical absorption, but in a polarisation e.m.f., which at room-temperature amounts to about 20 % and at the temperature of liquid air to about 85 % of the applied e.m.f. It is, for investigation of the electron motion in crystals, quite the same whether it is undertaken with light decomposed into a spectrum or with white light. J. J. S.

3198. *The Volta Effect.* **E. Dubois.** (Comptes Rendus, 185. pp. 110–111, July 11, 1927.)—In continuation of earlier tests [see Abstract 2756 (1927)] the author finds that by heating to temperatures not so high (*e.g.*, 500° C.) Ag, Au, Cu, and Pt are electropositive with regard to their initial state but become electronegative with further heating. Zn, Al, Ni and Fe do not show this reversal. Examination of impurities to account for the effect has commenced, and it is found that oxidation has no apparent effect. Distillation of alkaline chlorides on the metal causes the metal to become strongly electropositive. For Cu/Fe he finds (1) for new electrodes a voltage of 0·20, (2) after heating the iron *in vacuo* 0·60, (3) after distillation of KCl on the iron 1·00, and (4) after 15 hours 0·88. There is thus a time variation produced. The author considers that saline impurities on the surface and in the interior of the metal cause a considerable part of the temperature variations of the Volta effect. R. S. R.

3199. *Temperature Relations of Dielectric Constants.* **F. Maske.** (Phys. Zeits. 28. pp. 533–545, Aug. 1, 1927.)—Testing, with benzophenon, the Clausius-Mosotti expression $(\epsilon - 1)/(\epsilon + 2) \,.\, d^{-1} =$ a constant, the author finds a hyperbola $(\epsilon - 1)/(\epsilon + 2) \,.\, d_n^{-1} \,.\, (T - T') =$ a constant, where d_n is the density at 0° C. and 760 mm., and T, T′ are absolute temperatures; with benzophenon $T' = 414°$ C. absolute. As T rises this approximates to $\epsilon - 1 = 3dk/T = k'/T$, Sänger's experimental result. A. D.

3200. *Magnetic Field of an Elliptic Coil for a Sensitive Galvanometer.* **T. Ikebe.** (Imp. Acad. Tôkyô, Proc. 3. pp. 216–218, April, 1927.)—The paper contains a calculation of the field strength of an elliptic coil when used in a moving magnet galvanometer. [See also Abstract 2193 (1926).] E. G.

3201. *Best Form of Galvanometer Coil.* **T. Ikebe.** (Imp. Acad. Tôkyô, Proc. 3. pp. 219–222, April, 1927.)—Deals with the curves on which the spires of elliptic coils are to be wound to give the maximum sensitivity. Not suitable for abstracting. [See Abstract 2193 (1926) and preceding Abstract.] E. G.

3202. *A Hot-Wire Vacuum Gauge.* **A. M. Skellett.** (Optical Soc. America J. and Rev., Sci. Inst. 15. pp. 56–58, July, 1927.)—The gauge described is a modification of the Pirani hot-wire gauge, the filament of 1 mil tungsten wire, 5 cm. long, being mounted along the axis of a pyrex tube. In addition to the heating circuit, a subsidiary circuit is arranged, containing the filament, battery and galvanometer, such that with the highest obtainable vacuum a balance is obtained, the galvanometer giving no deflection. If a little gas is admitted, the filament loses heat by conduction, and changes resistance, thereby unbalancing the circuits and affecting the galvanometer. Pressures as low as 6×10^{-6} mm. are accurately measured; with a more sensitive galvanometer still lower pressures can probably be measured. E. T. A. R.

ALTERNATING CURRENTS AND MAGNETISM.

3203. *Motion of Translation of a Piezo Quartz Crystal in an Electrical Field.* **S. J. Hirschhorn.** (Zeits. f. Physik, 44. 3. pp. 223–225, 1927.)—When the crystal is placed unsymmetrically between condenser plates, connected with a high-frequency circuit, the crystal moves into the symmetrical position as soon as the connection is made, provided the friction is not too great. In the experiments the crystal was supported by a vertical thread between the condenser plates. H. N. A.

3204. *Current Displacement in Right-Angled Conductors.* **M. J. O. Strutt.** (Ann. d. Physik, 83. 7. pp. 979–1000, Aug. 9, 1927.)—A mathematical paper. J. J. S.

3205. *Demagnetisation of Iron Compounds by Electric Vibrations.* **M. Tschetverikova.** (Zeits. f. Physik, 44. 1–2. pp. 139–145, 1927. Paper read at the fifth congress of the Russian Physical Assoc. in Moscow, Dec. 19, 1926.)—An investigation was made of the decrease of the residual magnetism of non-conducting iron compounds in the form of powder in damped magnetic alternating fields with periods varying between $0 \cdot 02$ and $9 \cdot 3 \times 10^{-10}$ sec. Upon raising the periodic number an increase was observed in the initial field necessary for the demagnetisation. The material used was iron scales and magnetite in the form of powder. Demagnetisation in short Hertzian waves—from $\lambda = 1700$ cm. to $\lambda = 28$ cm.—was observed. In slowly alternating fields the demagnetisation was observed only when the field strength was not under $2 \cdot 3$ gauss. No demagnetisation was observed under the action of undamped waves. J. J. S.

3206. *Single Iron Crystals. Part III. Magnetisation in Different Crystal Directions.* **E. Dussler** and **W. Gerlach.** (Zeits. f. Physik, 44.

4–5. pp. 279–285, 1927.)—New measurements on the magnetic behaviour of iron crystals confirm previous data [see Abstract 789 (1927)]. A comparison has now been made between the present results and those of Honda and Kaya, and also the qualitative and quantitative characteristics of iron crystals in different directions ascertained. Curves are given showing the magnetisation effect parallel to the digonal and tetragonal axes and the corresponding hysteresis phenomena. H. H. Ho.

3207. *Experimental Method for the Determination of the Ballistic Demagnetisation Factor.* **E. Dussler.** (Zeits. f. Physik, 44. 4–5. pp. 286–291, 1927.)—The present investigation endeavours to provide a more exact knowledge of the demagnetisation factor. Previous methods [C. Benedicks, see Abstract 503 (1902)] are only applicable to homogeneous isotropic rods and do not permit the determination of a change of the demagnetisation factor in connection with structural alteration (*e.g.*, crystallisation). The method now described in detail has proved to be applicable to iron crystals. H. H. Ho.

3208. *The Magnetic Anisotropy of Crystalline Nitrates and Carbonates.* **K. S. Krishnan** and **C. V. Raman.** (Roy. Soc., Proc. 115. pp. 549–554, Aug. 2, 1927.)—A discussion upon the anisotropy of diamagnetic crystals, based upon the recent experimental data of Rabi [see Abstract 1893 (1927)] and others, obtained for sodium nitrate (trigonal), potassium nitrate (rhombic), calcite (trigonal) and aragonite (rhombic). Reasons are given why the magnetic anisotropy of these crystals can be attributed to the individual ions; and as the metallic ions are considered more or less isotropic, it follows that the anisotropy is to be looked for in the structure of the nitrate and carbonate ions. A table is given for the principal diamagnetic susceptibilities for the crystals mentioned. The susceptibility perpendicular to the plane of the NO_3^- ion is greater than for directions in the plane; the difference of susceptibility in the two directions is the same for the two nitrates. The magnitude of this anisotropy, if attributed to the NO_3^- ion, is exactly what is to be expected from the known values of magnetic birefringence (Cotton-Mouton effect) of nitric acid. However, it is pointed out at the beginning of this discussion that there is no justification in assuming that the NO_3^- ion is identical in the crystalline and liquid states. The explanation of the observed magnetic anisotropy of the NO_3^- ion is suggested on the basis of its peculiar electronic structure. This is supported by the fact that the CO_3^- ion, having essentially the same structure, gives almost the same anisotropy. Experimental work has been initiated by the authors to obtain further data on the magnetic susceptibilities of nitrates, silicates, carbonates and borates. J. K.

3209. *Atomic Grouping in Permalloy.* **L. W. McKeehan.** (Frank. Inst., J. 204. pp. 501–524, Oct., 1927).—A discussion of a problem in the local arrangement of atoms in an alloy and the development of an experimental graphical method of solution. The method consists of a paper treatment of a method which illustrates what has to be imagined to be done in three dimensions in the analytical method, and is described in detail and a lottery is used. In a previous paper the author pointed out that the peculiar magnetic properties of permalloy might be due to nearly perfect compensation, in a group containing one iron and four nickel atoms, of the magnetostrictions characteristic of the two pure metals. The paper demonstrates that the definite structure of a group containing only five atoms cannot be a proper picture of the facts and that it does not exist in sufficient numbers to justify its use in the explanation of permalloy. It is shown, however, that a group containing but five atoms can be tolerated if the structure of the group is less closely limited and provided that there is a tendency for the arrangement of atoms in crystals of a solid solution, to differ in a particular way from a purely chaotic arrangement first proposed. It is concluded that, on the basis of this quasi-experimental analysis, groups containing five atoms only—four of nickel all adjacent to one of iron, but otherwise free—suffice to explain the magnetic characteristics of permalloy. Mathematically such groups are sufficient but not necessary. Other physical methods have to be employed to explain the change of the magnetic state of permalloy with so little hysteresis. It is suggested that the method of treatment may be applied to the study of so-called resistance limits and also to the study of resistivity in moderately dilute solutions. S. G. B.

3210. *Theory of Paramagnetism.* **B. Cabrera.** (J. de Physique et le Radium, 8. pp. 257–275, June, 1927.)—The law of Curie-Weiss—$K(T + \Delta) = C$—is a definite experimental fact. Of the two constants, C and Δ, the first is characteristic of the paramagnetic atom in a certain state. Empirically all its values are such that $\sqrt{C} = nK$, where n is a whole number and K is a universal constant. As to Δ, there are no known limits to its possible values. It seems that the sudden change which the susceptibility—χ_a—of dissolved kations undergoes when the concentration varies depends sometimes on indiscernible alterations of Δ produced by the formation of complex kations at the expense of the bodies which are present. Langevin's theory leads to the calculation of the magnetic moment of each atom according to the constant C. The law of whole numbers reached empirically leads to the magneton of Weiss in a way equivalent to that followed by Weiss himself. Langevin's theory has been established for gases and gives as a first approximation simply the law of Curie for which $\Delta = 0$. For the greater part of bodies for which the Curie-Weiss law applies it cannot be used, for these bodies are solids or solutions. As to the *quantum* theory, it is more removed from the empirical results considered, and hence the justification for the attempts to obtain Langevin's formula from hypotheses differing from his own. Thus: (*a*) the electronic configurations which belong to the more superficial layers of the atom are thrown out of order each time the atoms come within a certain distance of each other; (*b*) the reorganisation takes place in such a way as to conserve the magnetic moment; in the case where there is an exterior field the probability of each orientation of the magnetic axis depends on the field and on the actions of the neighbouring atoms. These ideas developed in collaboration with Palacios gives approximately the formula of Curie-Weiss. Palacios has formulated a theory of the paramagnetism of crystals which takes account of the principal axes, or at least of their behaviour. J. J. S.

3211. *Theory of Paramagnetism.* **B. Cabrera.** (Comptes Rendus, 185. pp. 346–348, Aug. 1, 1927.)—The property of paramagnetism depends upon atoms with non-saturated electronic levels. The most important cases are produced during the formation of the sub-stages IV and V, and also VI and VII (in the case of the rare earths). The orbits of these sub-stages are determined in the first place by the structure of the lower stages, but as these orbits form the actual surface of the atom, or are found immediately below, they are very sensitive to external influences. The importance of the deformations produced depends (*a*) on the rigidity of the electronic configuration itself, estimated by its energy; (*b*) on the distance between the atom considered and those around it; and (*c*) on the nature of these atoms. This last influence can be eliminated by considering always bodies of the same chemical composition. As to (*b*), it is necessary to take account of the thermal agitation which intervenes. For the case of monatomic gases, the perturbations are produced only during the collisions. Their elastic nature (well established empirically) must be interpreted by the change of energy from the kinetic form to the potential form of deformation and inversely. But the time during which these phenomena occur is infinitely small compared with the duration of the free path, so that the function of the collision is reduced to providing a new way of changing the orientation of the magnetic axis of the atom. For the polyatomic gases, as for liquids and solids, there come in vibrations of each atom around the position of equilibrium, of which the amplitude is a function also of the temperature. In this case the atom may remain disorganised during a notable fraction of the period of vibration, so that the number of atoms which take part in the susceptibility measured diminishes with the temperature. A magnetic field produces an elastic deformation of the system of electrons which may be decomposed into two parts: (1) a variation of the velocity of the electrons in their orbits, which produces a diamagnetic effect according to Langevin's theory; (2) a change of the orientation of the magnetic axes of the orbits without variation of electron velocity which produces a paramagnetic effect. J. J. S.

3212. *Magnetic Fluctuations and Sunspot Frequency.* **J. M. Stagg.** (Meteorolog. Office, Geophys. Mem. No. 36, [24 pp.] 1927.)—A discussion based primarily on the daily ranges of declination as recorded at Kew Observatory, Richmond, during the 67 years, 1858–1924.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

3213. *The Heating of Tissues by High-Frequency Currents.* **d'Arsonval.** (Comptes Rendus, 185. pp. 324–327, Aug. 1, 1927.)—The physiological effect of high-frequency currents as used in medicine (d'Arsonval current) is not solely due to the Joule effect. In the same subject the sensibility may vary from day to day. Solutions of salt, drinking water, horse serum and urine, with varying concentrations, give, with constant current and time, variations in temperature-rise which do not conform to the values which would appertain if the effects were solely due to the Joule effect. These differences may be due to the condenser action of the electrodes and dielectric viscosity. The skin effect is negligible. It is concluded a hot-wire ammeter is not sufficient to measure the degree of heat which may result when tissues are heated by means of diathermy. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

3214. *Storch Equation, a General Dilution Formula, and the Validity of the Law of Mass Action at Limiting Dilutions.* **A. Ferguson** and **I. Vogel.** (Phil. Mag. 4. pp. 1–17, July, 1927.)—The application to different electrolytes of the Storch equation, $(C\alpha)^n/C(1-\alpha) = K$, either with constant exponent or in a more general form with the exponent n considered as a linear function of the concentration, is discussed. The electrolytes examined include strong, intermediate or transition, weak, uni-uni-, uni-bi-, and bi-bivalent forms, and the concentrations varied over a considerable range. The results indicate that the Storch equation in its simple or in a generalised form is the one which most satisfactorily represents the relation between $\alpha(=\Lambda/\Lambda_0)$ and C over a wide range of concentration. This relation, which is undoubtedly followed accurately at low concentrations, serves to test Ostwald's dilution law. As a general rule, this law is not followed, since with only two of the nineteen substances considered is reasonably good agreement with this formula exhibited. T. H. P.

3215. *Double Refraction and Thixotropy of Aluminium Hydroxide Sols.* **M. Aschenbrenner.** (Zeits. phys. Chem. 127. 5–6. pp. 415–445, July, 1927.)—The occurrence of double refraction in alumina sols in relation to the concentration and to the presence of electrolytes is considered, to some extent, quantitatively. The effect of electrolytes is shown only within a certain concentration region. The double refraction is increased for a time to a degree dependent on the concentration of the electrolyte and on the valency and adsorbability of the active ion. Distinct parallelism is observed between the appearance of double refraction and that of thixotropy or the reversible sol-gel transformation occurring when the fluid sol is shaken. Double refraction, like the velocity of solidification, is depressed by the addition of protective substances such as gelatine or amino-acids. The double refraction of the sol is completely inhibited by heating in presence of an electrolyte, but it is increased considerably in the case of the pure sol. Dialysis also results in marked increase in the double refraction, which is then destroyed by small additions of electrolyte. Excessive viscosity of the sol diminishes the double refraction, which undergoes increase when the viscosity is decreased by shaking; too vigorous shaking, however, causes a fall in the double refraction. Although the parallelism between double refraction and thixotropy is far-reaching, the one phenomenon does not condition the other, since a thixotropic sol is not always doubly refracting. It is probable that two factors play a part in the alteration of state of the sol under the influence of electrolytes, namely, the number of united particles and the nature of their union; these factors act in the same sense on the viscosity, but in opposite senses on the double refractivity. T. H. P.

3216. *Structure of Gels: Crystallisation of l-Arabinosazone.* **P. Thomas** and **Marie Sibi.** (Comptes Rendus, 185. pp. 540–542, Sept. 5, 1927.) An examination is made of the type of crystals given by *l*-arabinosazone when alone and when in presence of cherry-tree gum when the amounts are in ratios of gum to *l*-arabinosazone varying from 1 : 50 to 1 : 5. The pure compound is found to crystallise in the form of small clusters of fine, short radial crystals which are arranged regularly around a centre. The smallest proportion of gum gives very fine, short flexuous filaments which, with increasing quantity of gum, become progressively longer and assume the form of hairs which occlude considerable amounts of water. The results support the hypothesis according to which gels consist of a mass of long felted ultramicroscopic crystals with the interstices filled with liquid. [See also Abstract 2727 (1926).]

J. N. P.

3217. *Binary Mixtures of Volatile Liquids Capable of Forming a Compound.* **F. Michaud.** (Comptes Rendus, 185. pp. 108–110, July 11, 1927.) On lines similar to those followed in a previous paper [see Abstract 2731 (1927)], formulæ are developed which permit of the construction of vapour pressure isothermals. The method is illustrated by the case of ethyl oxide and chloroform. In studying the effects of the presence of non-volatile solids in solution in such mixtures, it is noted, *e.g.*, that saturation of the above mixtures with acetanilide at the same temperature is without effect on the constant of the law of mass action.

A. B. C. L.

3218. *Dissociation of Carbon Dioxide at High Temperatures.* **R. W. Fenning** and **H. T. Tizard.** (Roy. Soc., Proc. 115. pp. 318–333, July 1, 1927.)—The initial composition of the mixture of gases is represented by $2(1 + a)CO + O_2 + bN_2$, and that at the highest temperature after explosion, T_e, by $2(1 - x)CO_2 + 2(a + x)CO + xO_2 + bN_2$. It is shown that if b is kept constant and a is varied the amount of residual oxygen $x = a/b$ when T_e is a maximum, and it can be proved that P_e, the highest pressure after explosion, is a maximum when T_e is a maximum. In the experiments b was kept constant in each series, a was varied and the values of P_e were plotted against the original volume ratio of CO to O_2 in the mixture. The maximum value of P_e for each of the curves was taken, the corresponding value of T_e calculated, and so the value of x, and hence of the dissociation constant K_p, at this temperature became known. The values obtained were checked by a method which has been used by Bjerrum and others. The authors' values of K_p are considerably lower than those of Bjerrum. Reasons are given for this.

H. N. A.

3219. *Catalytic Decomposition of Ammonia.* **G. M. Schwab.** (Zeits. phys. Chem. 128. 3–4. pp. 161–181, Aug., 1927.)—At high temperatures the decomposition of ammonia represents a complicated process. At low temperatures the velocity of decomposition in presence of platinum or tungsten may be represented by the equation: $-\frac{dc}{dt} = \frac{kc}{\delta n + \epsilon h}$, where c, n and h are the pressures of the ammonia, nitrogen and hydrogen respectively. This equation is capable of a simple interpretation by means of Langmuir's catalytic theory of unimolecular layers. At high pressures, with which other measurements indicate the disappearance of the inhibition caused by nitrogen, this theory is, however, no longer of value. In this case either adsorption in multi-layered strata must be assumed for hydrogen, or the existence on the surface of regions of different adsorptive capacities. T. H. P.

3220. *Reaction between Chlorine, Hydrogen and Oxygen in Light.* **E. Cremer.** (Zeits. phys. Chem. 128. 3–4. pp. 285–317, Aug., 1927.)—An experimental method for studying the reaction between chlorine, hydrogen and oxygen when exposed to light was developed. The velocity of the reaction was measured, and it was found that the velocity of the formation of water was so small compared with the velocity of formation of hydrochloric acid that it did not change the concentration of the oxygen to any marked degree. The exact law for the formation of hydrochloric acid is given by the equation

$$d[2\mathrm{HCl}/dt = \mathrm{K}_c[\mathrm{Cl}]^2[\mathrm{H}_2]/[\mathrm{Cl}]^2 + \mathrm{K}'[\mathrm{H}_2][\mathrm{O}_2],$$

and for the formation of water

$$d[2\mathrm{H}_2\mathrm{O}]/dt = \mathrm{K}_w[\mathrm{Cl}_2].$$

The deviations of the results obtained from the observations of previous investigations is probably due to the sensitiveness of the reaction between hydrogen and chlorine to catalytic influences. F. J. B.

3221. *Combination of Nitrogen and Hydrogen Activated by Electrons.* **A. Caress** and **E. K. Rideal.** (Roy. Soc., Proc. 115. pp. 684–700, Aug. 2, 1927.)—The various possible mechanisms for the production of NH_3 in mixtures of N and H by means of thermions are investigated in detail. It is shown that synthesis can occur due to the following reactions: (*a*) $N_2 + H$ at the surface of Pt or Ni; (*b*) $N_2 + H'$ in the bulk at 13 volts. The following molecular species are shown to be chemically reactive: (*a*) N_2^+ in the bulk at 17 volts; (*b*) N^+ in the bulk at 23 volts, and possible modes of mechanism involving N_2' and H' are elaborated. A. B. C. L.

3222. *Reactions of Incandescent Tungsten with Nitrogen and Water Vapour.* **C. J. Smithells** and **H. P. Rooksby.** (Chem. Soc., J. pp. 1882–1888, Aug., 1927.)—In lamps of high temperature, tungsten is volatilised and deposited on the bulb as a black mirror. To avoid this the lamp is filled with inert gas, usually argon with 10 or 20 % of nitrogen. Lamps of 500 watts and more are charged with nitrogen alone; but a dark brown deposit is slowly formed of which up to 10 mg. were found in a 4-litre bulb after 1000 hours burning. X-ray analyses of tungsten, its three oxides (WO_3 yellow, W_2O_5 blue, WO_2 chocolate-brown) and the deposit indicated a nitride. Combustion of the deposit with potassium permanganate in a spectrum tube proved it to be WN_2, approximately of density 5. As regards water vapour, the reversible reaction $W + 2H_2O \rightleftarrows WO_2 + 2H_2$ takes place in such a way that the hot parts of tungsten are oxidised and the oxide is reduced to metal at lower temperatures and deposited on cooler parts of the filament, while the bulb blackens. This blackening might be due to oxide and metal; but X-ray examination showed no trace of oxide. It would therefore appear that oxide molecules, which probably do reach the glass walls, are reduced by the atomic hydrogen formed by the contact between molecular hydrogen and incandescent tungsten (Langmuir), and that would explain how one part of water vapour in 10,000 will burn out a lamp filament in less than an hour. H. B.

3223. *Phenomena of Luminescence with Oxidising Reactions in Aqueous Solutions.* **L. Mallet.** (Comptes Rendus, 185. pp. 352–354, Aug. 1, 1927.)—It has been found that numerous oxidising reactions are accompanied by the production either of visible light, or of light made apparent by the photographic plate, or by fluorescent substances. A number of experiments are here given which contribute to the belief that the emission of luminous radiations must be a very general phenomenon, at least in the course of oxidising reactions. They also afford a verification of the hypothesis of Jean Perrin according to which all chemical reactions, ruptures or joining of valencies are accompanied by the emission or absorption of light. It is probable that many physico-chemical and biological effects are due to these phenomena. A. E. G.

3224. *Chemical Constants of Biatomic Molecules.* **F. J. v. Wiśniewski.** (Zeits. f. Physik, 44. 4–5. pp. 392–394, 1927.)—The constants of chemical equilibrium between two biatomic molecules computed from the models; found to agree with data experimentally obtained. A. D.

3225. *The Electronic Theory of the Voltaic Cell.* **O. M. Corbino.** (Phil. Mag. 4. pp. 436–446, Sept., 1927.)—A discussion of theory similar to that given in a former paper [see Abstract 1579 (1927)]. Reference should also be made to the paper by Butler [see Abstract 458 (1925)]. G. E. A.

3226. *Some Current-Time Relations in the Aluminium Cell.* **W. E. Meserve.** (Phys. Rev. 30. pp. 215–222, Aug., 1927.)—The relation between current and time in an aluminium cell with the aluminium as anode and with d.c. applied voltage has been investigated. Apparatus and methods for obtaining data are described whereby many of the difficulties which have in the past hindered observers in obtaining consistent results have been overcome. The results obtained are in agreement with the theory of Guthe as modified by Fitch [see Abstract 347 (1917)]. After the lapse of a certain time (t_0), which was found to be about 300 seconds, from the moment of applying the voltage, the dependence of current on voltage conforms to the relation $E/i^2 = Ct + D$. From this is deduced a linear relationship between E/i and the quantity of electricity passing through the cell, ($E/i - E/i_0 = Cq/2$). The slope, $Cq/2$, is in the nature of a resistance, and assuming that it represents the resistance of the oxide layer, the thickness and resistivity ($3{\cdot}403 \times 10^{12}$ ohm cm.) of the layer are computed. The data obtained show that the slopes of these lines vary inversely with the square of the anode area, which checks with the theory. Results obtained by Güntherschulze [see Abstract 1340 (1921)] with tantalum are compared and are shown to check the theory. After a short time of closed circuit the opposition to the flow of current when the aluminium is the anode is shown to be due primarily to the ohmic resistance of the solid layer which increases in value with the time of the closed circuit. AUTHOR.

3227. *Methods for the Determination of Flow Potential.* **H. Lachs** and **J. Biczyk.** (Phys. Zeits. 28. pp. 556–558, Aug. 1, 1927.)—Previous measurements of this quantity have been attended with considerable difficulty and are very unreliable. The present authors accordingly submit a process for which accuracy is claimed within 5 % for experiments in different series and 1 % in the same series. The paper consists entirely of experimental detail. H. H. Ho.

3228. *Potential of the Gold-Auric Oxide Electrode.* **R. H. Gerke** and **M. D. Rourke.** (Am. Chem. Soc., J. 49. pp. 1855–1858, Aug., 1927.)—The authors endeavoured to study the properties of the gold-aurous oxide electrode, but they were unsuccessful in preparing aurous oxide by any of the methods described in the literature. It was noticed that the potential of the gold-auric oxide electrode was about the same as that recorded for the gold-aurous oxide electrode, and doubt was raised whether aurous oxide had ever been prepared. The potential of the gold-auric oxide electrode, Au(cryst), Au_2O_3(s), H, was found to be 1·362 volts. The free energy of formation of auric oxide at 25° C. was found to be + 18,810 cal. from electromotive force measurements. It was also shown that it is doubtful if pure aurous oxide had ever been prepared. F. J. B.

3229. *Free Energy of Auric Oxide from Measurements of the Gold-Auric Oxide Electrode.* **T. F. Buehrer** and **W. E. Roseveare.** (Am. Chem. Soc., J. 49. pp. 1989–1991, Aug., 1927.)—Measurements were made of the cell: H(g), $H_2SO_4(x-M)$, Au_2O_3(s), Au(s) at three concentrations of sulphuric acid and at 25° C. The electromotive force was found to be practically independent of the concentration of the sulphuric acid; the general average was $1{\cdot}364 \pm 0{\cdot}001$ volts. The free energy of formation of auric oxide from its elements, its dissociation pressure and entropy of formation at 298° absolute were calculated, and indicated that auric oxide is an extremely unstable compound. F. J. B.

3230. *Diffusion-Potential Measurements applied to Hydrochloric Acid-Gelatine Systems.* **A. L. Ferguson** and **E. K. Bacon.** (Am. Chem. Soc., J. 49. pp. 1921–1939, Aug., 1927.)—Measurements are made of the static liquid junction potentials between hydrochloric acid of two concentrations and of the systems hydrochloric acid-sodium chloride, and hydrochloric acid-gelatine, the concentration of gelatine being varied from 0 to 17%. The change from liquid to solid state of the gels has no noticeable effect on the potentials which, with the supposedly complex gelatine systems, are as accurately reproducible and as definite as with the simpler hydrochloric acid-sodium chloride systems. The observed potentials between the free acid and the acid in presence of gelatine at concentrations varying from 0·01 N to 0·10 N are closely similar to those given by hydrochloric acid and sodium chloride. It is concluded that isoelectric gelatine is able by its amphoteric character to combine with hydrochloric acid, giving the highly ionised salt gelatine chloride. The amount of gelatine combining with 1 gramme-equivalent of hydrochloric acid is estimated to be 1090 grammes. The introduction of an excess of uncombined gelatine at one of the diffusion boundaries where free hydrochloric acid is present leads to an indeterminate and fluctuating potential through interaction to form gelatine chloride. J. N. P.

3231. *Electrode Potentials of Be, Mg, Ca, Si, Ba.* **W. M. Latimer.** (J. Phys. Chem. 31. pp. 1267–1269, Aug., 1927.)—These potentials calculated from the values for the entropies of the aqueous ions together with the entropies of the elements and the heats of solution of the metals in acid. A. D.

3232. *Theory of Strong Electrolytes.* (Faraday Soc., Trans. 23. pp. 333–542, Aug., 1927.)—A treatise on the subject under the two headings: Part I, "Mobilities of Ions," and Part II, "Activity," comprising the following twenty-six papers, together with five general discussions:

"Report on Conductivity of Strong Electrolytes in Dilute Solutions" (Introductory Address to Part I), by **P. Debye**; "Report on a Revision of the Conductivity Theory," by **L. Onsager**; "Refractometric Evidence for the Existence of Undissociated Molecules and Complex Ions in Solutions of Strong Electrolytes," by **K. Fajans**; "Electrolytic Transference of Water, True Transference Numbers, Ionic Mobilities and Water Sheaths of the Ions," by **H. Remy**; "Ionic Mobilities in Non-Aqueous Solvents," by **H. Ulich**; "The Mobilities of the Elementary Forms in Methyl Alcohol," by **H. Hartley** and **H. R. Raikes**; "Notes on the Debye-Hückel Theory," by **H. Hartley** and **R. P. Bell**; "The Ionisation of Some Typical Strong Electrolytes," by **D. A. MacInnes** and **I. A. Cowperthwaite**; "On the Agreement with Experiment of the Dilution Formula Deduced from the Debye-Hückel Theory," by **A. Ferguson** and **I. Vogel.**

"On the Activity of Electrolytes" (Introductory Paper to Part II), by **J. N. Brönsted**; "Strong Electrolytes in Relation to Statistical Theory, in Particular the Phase Integral of Gibbs," by **R. H. Fowler**; "Note on the Interionic Attraction Theory of Debye and Hückel," by **D. L. Chapman**; "Some Anomalies in the Theory of Solution of Strong Electrolytes and their Explanation," by **N. Bjerrum**: "Mixed Solutions of Electrolytes and Non-electrolytes," by **G. Scatchard**; "On the Thermodynamic Dynamic Properties of a few Concentrated Salt Solutions," by **H. S. Harned**; "An Electrometric Study of the System Potassium Chloride—Lead Chloride Water at 25° C.," by **A. J. Allmand** and **L. J. Burrage**; "Note on the Occurrence of Points of Inflection in the Concentration-Vapour Pressure Curves of Aqueous Solutions of Certain Electrolytes," by **A. J. Allmand**; "Activity of Zinc Chloride in Concentrated Solution," by **F. Foxton** and **W. J. Shutt**; "Influence of Electrolytes on the Solubility of other Electrolytes in Non-Aqueous Solvents," by **C. A. Kraus** and **R. P. Seward**; "Use of Amalgam Electrodes for Determining Activities in Methyl Alcohol," by **J. H. Wolfenden, C. P. Wright, N. L. Ross-Kane** and **P. S. Buckley**; "Significance of the Activity Coefficient," by **M. Randall**; "Methods of Calculation of Activity Coefficients," by **M. Randall**; "Molecular Structure of Strong and Weak Electrolytes. (*a*) Complete Ionisation (The Electronic Theory of Valency, Part V)," by **T. M. Lowry**; "Note on the Activity of Hydrogen Ion in Mixed Solvents," by **H. Millet**; "Effect of One Salt on the Solubility of Another in Ethyl Alcohol Solution, Part I. Part II. Quantitative Discussion of the Solubility of Sodium Iodide in the Presence of Sodium Thiocyanate," by **F. E. King** and **J. R. Partington**; "Activity Coefficients of Protein Ions," by **G. S. Adair.**

3233. *Electrolytic Crystallisation Processes. Part I.* **V. Kohlschütter.** (Zeits. Elektrochem. 33. pp. 272–277, July, 1927.)—Previous publications dealing with the forms assumed by metals deposited electrolytically, and with the factors influencing such forms, are discussed. [See the following two Abstracts.] T. H. P.

3234. *Electrolytic Crystallisation Processes. Part II. Aggregation Forms of Loose Metallic Precipitates.* **V. Kohlschütter** and **A. Good.**

V.
19

(Zeits. Elektrochem. 33. pp. 277–289, July, 1927.)—Results are given of investigations on the forms assumed by electrolytic deposits of lead, cadmium, zinc, tin, silver and thallium, the methods of Kohlschütter and Uebersax [Abstract 1973 (1924)] being used. Each metal has its peculiar "wild growth" and yields separation forms which, as a whole, embody a definite morphological type, recognisable even without the aid of optical or other means. Of the factors participating in this effect, those determining the magnitude of the individuals depend on the relation of germ formation and growth; this depends on current density, concentration of electrolyte and temperature, but is also a distinct function of the nature of the metal. The aggregation type, and hence the whole shape of the formation, are decided by the manner in which the crystals join themselves together. The effects observed give the impression that the mode of deposition of one crystal on another is determined not merely by the germs already present but, to some extent, by those newly formed. The development of fibre-like crystal chains is apparently favoured by a certain current density and by concentration of the current lines on growing nuclei. It is, therefore, related to chemical polarisability. [See Abstract 2197 (1924).] T. H. P.

3235. *Electrolytic Crystallisation Processes. Part III. Formation and Properties of Cohering Metallic Layers.* **V. Kohlschütter** and **F. Jakober.** (Zeits. Elektrochem. 33. pp. 290–308, July, 1927.)—Investigation of the development of very thin kathodic metal deposits by following the mechanical alterations in the layers is employed as a means of obtaining information on the constitution of the finely divided crystalline aggregates of dense metallic deposits. The observations made indicate the occurrence of structural transformations in the precipitates which become interlaced during the formation of the metal. These transformations are rendered evident by either contractions or expansions of the layers. Contraction during deposition occurs only when the metal is highly dispersed and the electrode is coated uniformly from the beginning of the action. Expansion appears with metals exhibiting marked inclination to the formation of separate crystals and obtainable as dense deposits only from certain electrolytes. One of the causes of spontaneous contraction is assumed to be an after-crystallisation, which may result in mere coarsening of the granules by aggregation, in increase of certain crystals at the expense of others, or in orientation of non-arranged crystallites. Contraction may be influenced also by atomic forces. Another cause of the formation of disperse metallic deposits lies in the accompanying discharge of hydrogen ions, which may yield hydrides as intermediate compounds which leave disperse metal on decomposition. Moreover, the hydrogen may enter the metal lattice and the osmotic laws be observed at the same time. Just as is the case with loose metallic deposits [see preceding Abstract], so also with the dense disperse precipitates, each metal exhibits a typical form. This form and its variation depend on the nature of the metal itself and also on the properties and behaviour of its compounds occurring in the electrolyte. T. H. P.

3236. *The Mechanism of Electrolytic Current Conduction in Crystals.* **A. Reis.** (Zeits. f. Physik, 44. 4–5. pp. 353–358, 1927.)—The experimentally reached conclusion that in electrolytically conducting crystals only a noticeable mobility of an ionic kind exists is referred to the known results of experiment on the deformation of the ions. At the spot which exhibits a disturbance of the ideal crystal lattice will ions qualify for change of place, if the one-sided connection through the neighbour does not suffice for fixation. Strongly deforming ions have the capacity of holding fast easily deformable ions, but not *vice versa*. **Errata** (ibid. 45. 5–6. p. 449, 1927). J. J. S.

3237. *Calculation of the Equivalent Conductivities of Strong Electrolytes at Infinite Dilution. Part I. Aqueous Solutions. 3. The Mobilities of the Hydrogen and the Hydroxyl Ions.* **A. Ferguson** and **I. Vogel.** (Phil. Mag. 4. pp. 300–305, Aug., 1927.)—The calculation of the equivalent conductivities at infinite dilution described in a previous communication [see Abstract 3012 (1927)] was continued. The method of calculation was applied to the case of the hydrogen ion, for which no satisfactory value was known, and to the case of the hydroxyl ion, which was also uncertain. The most probable values for the conductance at infinite dilution of the hydrogen ion at 25° C. and of the hydroxyl ion at 18° C., deduced by the authors' method [see Abstract 651 (1926)], are 349·05 and 175·4 respectively. F. J. B.

3238. *Electrolytic Solution Forces and Ionic Condition.* **K. Fredenhagen.** (Zeits. phys. Chem. 128. 1–2. pp. 1–24, and 3–4. pp. 239–265, Aug., 1927.)—Normal potentials of Cl', Br', I', HO_3' and OH' in the solvent water, methyl and echyl alcohol, and liquid ammonia and hydrofluoric acid, are calculated from the ionic concentration of saturated solutions of the silver and alkali metal salts by means of a formula derived from the relation that saturated solutions of a given salt in different solvents will have the same decomposition voltage. Ionic concentrations are determined by conductivity measurements and by potential measurements of concentration cells. The order of solubility of the silver halides and the potential series of the anions in ammonia is the reverse of that in water. Allowance is made for the dissociation of the solvent itself and the contained impurities. It is found that the dielectric constant is not the main factor which determines the dissociating and solvent power of different solvents. Hydrocyanic acid which has the highest dielectric constant has by far the lowest dissociating and solvent power of the liquids measured. Moreover, the results show that solvents cannot be classified into good and poor solvents, since solvent power does not reside in any specific properties of a liquid but on a reciprocal inter-relation between specific groups in solute and solvent.

A thermodynamical cycle is considered with an element which can exist in equilibrium with a binary compound in both liquid and gaseous phase. The following equation is derived: $k' = \frac{kP_BP_S}{L_{(BS)}}$, where k' is the dissociation constant of a binary compound in the liquid phase, and k that in the gas phase, P_B, P_S the electrolytic solubility numbers, and $L_{(BS)}$ the distribution ratio of undissociated compound in the two phases, or the Henry coefficient. The formula is supported by experimental data with the hydrogen halides. Explanations are given for the practically complete dissociation of neutral salts, low temperature coefficients and departures from the dilution law. J. N. P.